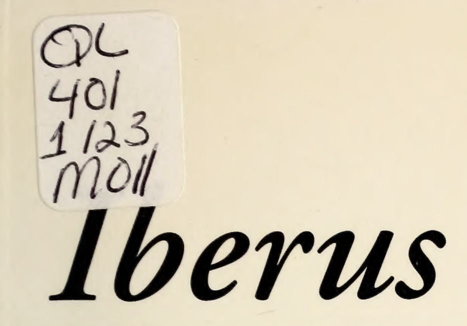


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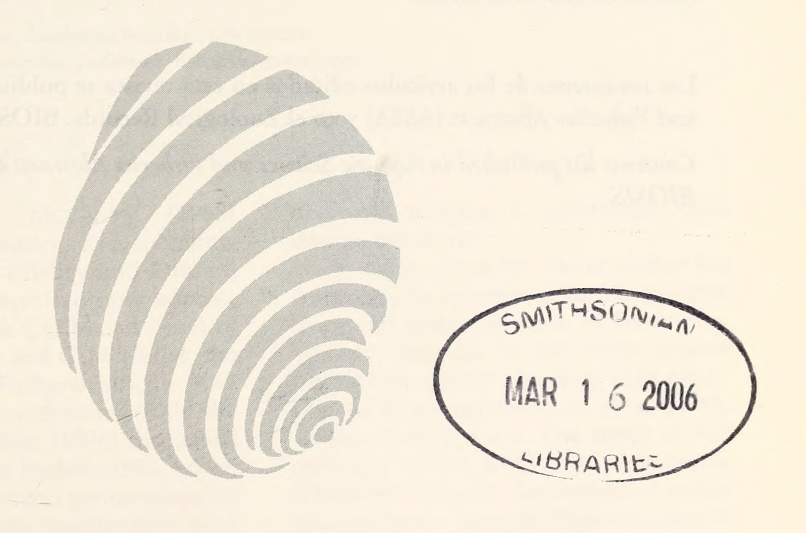
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PORTADA DE *Iberus*

Iberus gualterianus (Linnaeus, 1758), una especie emblemática de la península Ibérica, que da nombre a la revista. Dibujo realizado por José Luis González Rebollar "Toza".

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A new species of *Lodderena* (Gastropoda: Skeneidae) from the Bahamas

Una nueva especie de *Lodderena* (Gastropoda: Skeneidae) de las Bahamas

Colin REDFERN* and Emilio ROLÁN**

Recibido el 26-I-2005. Aceptado el 30-VI-2005

ABSTRACT

A new species in the genus *Lodderena* (Gastropoda: Skeneidae) is described from the Bahamas. The new species is compared to *L. ornata* (Olsson and McGinty, 1958).

RESUMEN

Se describe una nueva especie del género *Lodderena* (Gastropoda: Skeneidae) de las Bahamas. La nueva especie se compara con *L. ornata* (Olsson and McGinty, 1958).

KEY WORDS: Skeneidae, *Lodderena*, Bahamas, new species.
PALABRAS CLAVE: Skeneidae, *Lodderena*, Bahamas, nueva especie.

INTRODUCTION

Olsson and McGinty (1958) described *Pachystremiscus* as a subgenus of *Cyclostremiscus* Pilsbry and Olsson, 1945. Included were two new species described from the Caribbean coast of Panama: *C. ornatus* and *C. pulchellus*, the type species of *Pachystremiscus*. Kay (1979) figured two species from the Pacific. Moolenbeek (1996) discussed the genus *Lodderena* Iredale, 1924, which is considered the correct genus name for this group of species, mentioning most of the existing taxa and describing two new species.

Rubio, Rolán and Redfern (1998) studied species of *Lodderena* occurring in the Caribbean, including some specimens from other areas that suggested a wider distribution. They also described one new species, *L. janetmayae* from Abaco, Bahamas.

In recent years the senior author has continued to examine sediment samples from the Bahamas. One of these contained examples of the three known Caribbean species together with examples of what appeared to be a fourth, undescribed species. The study of this material is the subject of this paper, which includes the description of a new species that is morphologically close to *L. ornata.*

MATERIAL AND METHODS

This study is based on a 0.4 liter sample of sediment collected at a depth

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of 6 m at Lynyard Cay, Abaco, Bahamas.

Abbreviations:
AMNH American Museum of Natural History, New York
ANSP Academy of Natural Sciences, Philadelphia
BMNH The Natural History Museum, London
BMSM Bailey-Matthews Shell Museum, Sanibel, Florida, USA
MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Musèum Nationale d'Histoire Naturelle, Paris
ZMB Zoologisches Museum, Berlin
CCR Collection of Colin Redfern, Boca Raton, Florida, USA
CER Collection of Emilio Rolán, Vigo

RESULTS

Family SKENEIDAE Clark, 1851
Genus *Lodderena* Iredale, 1924

Lodderena bunnelli n. sp. (Figs. 1-9)

Type material: Holotype (Figs. 1, 9), 0.56 mm, deposited at ANSP. One paratype deposited in each of the following collections: MNCN (15.05/46685) (Figs. 2, 8), 0.64 mm; MNHN (Fig. 3), 0.56 mm; AMNH (Figs. 4, 7), 0.58 mm; BMNH (Fig. 5), 0.56 mm; ZMB (Fig. 6), 0.60 mm; BMSM. 3 paratypes in CER and 21 in CCR. All type material consists of empty shells collected from the type locality in August, 2004.
Type locality: Lynyard Cay, Abaco, Bahamas in 6 m.
Etymology: Named for Rodger R. Bunnell, who collected the sediment sample that contained the type material.

Description: Shell (Figs. 1-6) very small, rounded, dorsally planispiral, whitish. Protoconch (Figs. 8, 9) approximately 200 μm in diameter, with about one whorl, nucleus rounded, surface roughened, with 1-2 spiral lines of irregular granules. Separation from the teleoconch is rather well defined. Teleoconch with only one whorl, sometimes a little less. Sculpture is formed dorsally by irregular undulating axial ribs that are well separated initially but become narrower, more numerous and crowded as the whorl develops. The beginning of the peripheral curvature is marked by a narrow spiral cord, above which a series of fine spiral threads starts to form when the whorl is about half developed. The strengthening spiral sculpture, subsequently consisting of up to 9-10 threads, causes the axial ribs to shorten, but they lengthen again just behind the aperture. Sculpture on the rounded periphery of the shell initially consists of three weak, irregular spiral cords that are connected by axial threads of similar strength to form a net-like pattern of ovoid or rectangular shapes (Fig. 7). After the first half of the whorl this pattern is replaced by spiral threads, one of which is a little stronger and sometimes forms a peripheral angulation. Ventrally the sculpture is very similar, but with the addition of short, widely-spaced axial riblets adjacent to the lower peripheral cord. Occasional shells have a spiral row of nodules close to the suture.

Aperture regularly rounded, with a double peristome.

Microsculpture: Under high magnification, small granules can be seen in the peripheral area (Fig. 7), with very fine axial lines elsewhere.

Dimensions: the holotype is 0.56 mm in maximum diameter, and the largest specimen studied is 0.64 mm.

Distribution: *Lodderena ornata* and *L. pulchella* are widely distributed in the Caribbean area and it is likely that *L. bunnelli* n. sp. has a comparable range, as indicated by the similarity of a shell from the U. S. Virgin Islands figured as *Lodderena* sp. by RUBIO ET AL. (1998, fig.



Figures 1-9. *Lodderena bunnelli* n. sp., from Abaco, Bahamas (CCR). 1: holotype, 0.56 mm (ANSP); 2: paratype, 0.64 mm (MNCN); 3: paratype, 0.56 mm (MNHN); 4-6: paratypes, 0.58, 0.56, 0.60 mm (AMNH, BMNH, ZMB); 7: microsculpture, paratype (AMNH); 8: protoconch, paratype (MNCN); 9: protoconch, holotype (ANSP).

Figuras 1-9. Lodderena bunnelli, *n. sp., de Abaco, Bahamas (CCR). 1: holotipo, 0,56 mm (ANSP); 2: paratipo, 0,64 mm (MNCN); 3: paratipo, 0,56 mm (MNHN); 4-6: paratipos, 0,58, 0,56, 0,60 mm (AMNH, BMNH, ZMB); 7: microescultura, paratipo (AMNH); 8: protoconcha, paratipo (MNCN); protoconcha, holotipo (ANSP).*

Table I. Differences between *Lodderena ornata* and *Lodderena bunnelli* n. sp.
Tabla I. Diferencias entre Lodderena ornata *y* Lodderena bunnelli *n. sp.*

	L. ornata	*L. bunnelli* n. sp.
Dimensions	larger diam. between 0.66 – 0.92 mm n= 10 median= 0.78 mm	smaller diam. between 0.56 – 0.64 mm n=10 median= 0.58 mm
Spire	shell dorsally planispiral; periphery meets aperture near the centre	shell dorsally planispiral; periphery meets aperture near upper dorsal border
Teleoconch	1 whorl + $^{1}/_{8}$	1 whorl or a little less
Spiral sculpture	3 very prominent nodulose cords on each side	Usually no nodulose cords; occasionally a small one ventrally close to the suture
Spiral sculpture at the periphery (near beginning of teleoconch whorl)	three prominent cords; sometimes with axial threads forming irregular rectangles	three weak, irregular cords connected by axial threads forming ovoid or rectangular shapes
Spiral sculpture at the periphery (towards end of teleoconch whorl)	three prominent, laterally nodulose cords; intermediate spiral threads only at the end	rarely with cords; numerous spiral lines on a convex curvature
Thickness of outer lip	thicker, about a third of the diameter of the aperture	thinner, about a quarter of the diameter of the aperture
Nucleus of the protoconch	slightly ovoid	rounded
Microsculpture of the protoconch	irregular, mainly near the periphery	some irregular granules spirally aligned
Microsculpture of the teleoconch near the suture	fine	finer

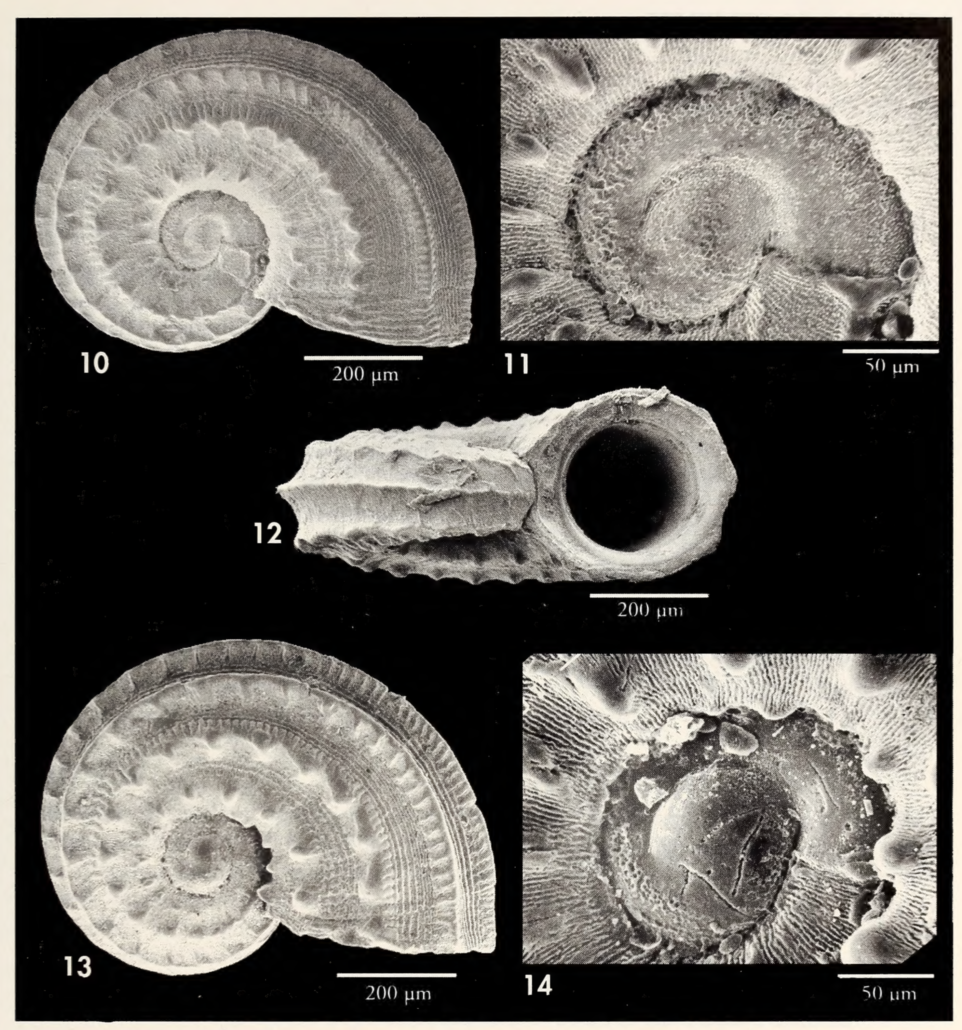
41). The existence of *L. bunnelli* n. sp. may have been overlooked elsewhere in the Caribbean due to its small size and possible confusion with *L. ornata*.

Remarks: The sediment sample that contained the type material of *L. bunnelli* n. sp. also yielded 12 examples of *L. janetmayae*, 20 of *L. pulchella* and 486 of *L. ornata*. Study of this material clearly showed that there was no intergradation between the four species.

MAYR (1963) stated that when two different morphs are found sympatrically without any intergradation between them, they represent two different species. Problems for the taxonomist occur when two different morphs share similar main characters. In the present case the distinction between *Lodderena bunnelli* n. sp. and *L. ornata* (Figs. 10-14), the closest species, was based on several different characters, and importance was also attached to the lack of any intergradation between these two sympatric species. Comparison of the two species showed us a number of differences, as summarized in Table I.

Another similar species is *Lodderena striata* (Kay, 1979) from Hawaii, but this species is larger (up to 1 mm), and the periphery ot the last whorl has only spiral striae, lacking the net-like pattern that is characteristic of *L. bunnelli* n. sp.

Records of *L. ornata* in RUBIO ET AL. (1998) from the Bahamas, Cuba, Cape Verde and São Tomé, together with those in the present work from the Bahamas, São Tomé and Easter Island, show that this species probably has a wide distribution in tropical seas, and that the morphological characters of the shell, including features of the protoconch, remain surprisingly constant throughout its range. *L. emeryi* (Ladd, 1966) is a taxon very similar to *L. ornata* and could even be conspecific (MOOLENBEEK, 1996).



Figures 10, 11. *Lodderena ornata*, 0.78 mm, Abaco, Bahamas (CCR). 10: shell; 11: protoconch. Figure 12. *Lodderena ornata*, 0.75 mm, São Tomé, West Africa (CER). Figures 13, 14. *Lodderena ornata*, 0.80 mm, Easter Island (CER). 13: shell; 14: protoconch.
Figuras 10, 11. Lodderena ornata, *0,78 mm, Abaco, Bahamas (CCR). 10: concha; 11: protoconcha. Figura 12.* Lodderena ornata, *0,75 mm, Santo Tomé, África occidental (CER). Figuras 13, 14.* Lodderena ornata, *0,80 mm, Isla de Pascua (CER). 13: concha; 14: protoconcha.*

It is surprising that one species such as *L. ornata* could be present in such widely separated areas, especially considering that the protoconch is paucispiral and does not have a long planktotrophic period that would allow wide distribution. We think that there are two possible explanations, the first of which is that dispersal could be attributable to human intervention, such as the discharge of ballast water from ships. Alternatively, this could be a case of reproductive isolation involving more than one species. Identification from widely separated geographic areas has been based solely on shell similarities, and the biology, ecology and soft parts are mostly unknown.

ACKNOWLEDGEMENTS

We thank Rodger R. Bunnell, of Sanibel, Florida, for providing the sediment sample that formed the basis of this study. We also thank Jesús Méndez of the CACTI, University of Vigo, for the scanning electron micrography.

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Los caenogasterópodos terrestres (Mollusca, Orthogastropoda) de la Comunidad Valenciana (España)

The land caenogastropods (Mollusca, Orthogastropoda) of the "Comunidad Valenciana" (Spain)

Alberto MARTÍNEZ-ORTÍ* y Fernando ROBLES**

Recibido el 8-III-2005. Aceptado el 30-VI-2005

RESUMEN

El estudio de las especies terrestres del Superorden Caenogastropoda, realizado a partir de la revisión bibliográfica, de colecciones museísticas y recolecciones propias, permite dar a conocer la presencia en la Comunidad Valenciana de *Cochlostoma (Obscurella) martorelli, Platyla polita polita, Leonia mamillaris, Pomatias elegans, Tudorella sulcata sulcata* y *Truncatella subcylindrica*. Se presentan datos sobre su registro fósil, los mapas de distribución geográfica en el área de muestreo, las características de sus hábitats y su estado de conservación en la Comunidad Valenciana. Además se amplía la distribución conocida de *P. elegans* hacia el sur de la Península Ibérica.

ABSTRACT

The study of the land species of the Superorder Caenogastropoda, by means of bibliographic examination, of collections from museums and our own collected samples, shows the presence in the "Comunidad Valenciana" of *Cochlostoma (Obscurella) martorelli, Platyla polita polita, Leonia mamillaris, Pomatias elegans, Tudorella sulcata sulcata* and *Truncatella subcylindrica*. The data of fossil registers of each species, geographical distribution maps in the sample area, the characteristics of their habitats and the state of conservation in the "Comunidad Valenciana" are hereby presented. Furthermore, the known distribution of *P. elegans* has been extended further South in the Iberian Peninsula.

PALABRAS CLAVE: Caenogastropoda, terrestre, Cochlostomatidae, Aciculidae, Pomatiidae, Truncatellidae, Comunidad Valenciana, España.
KEY WORDS: Caenogastropoda, Land, Cochlostomatidae, Aciculidae, Pomatiidae, Truncatellidae, "Comunidad Valenciana", Spain.

INTRODUCCIÓN

Desde 1989 los autores están realizando un muestreo sistemático de los moluscos continentales de la Comunidad Valenciana con una triple finalidad: obtener el censo completo de especies presentes en el área, concretar su distribución geográfica en la misma y analizar el estado de sus poblaciones, recomendando medidas de protección para las que se consideran amenazadas.

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Tabla I. Muestras estudiadas de caenogasterópodos terrestres, bibliográficas, revisadas y propias, de la Comunidad Valenciana (España).
Table I. Samples studied of the land caenogastropods, proceeding from bibliographic data, re-examined samples and our own, from the "Comunidad Valenciana" (Spain).

	Publicadas no revisadas	Publicadas y revisadas	Recolección autores	Colecciones (inéditas)	Registro fósil	Total
C. martorelli	1	1	7	1	-	10
P. p. polita	3	1	7	-	-	11
L. mamillaris	9	19	34	12	-	74
P. elegans	8	43	159	8	1	219
T. s. sulcata	-	-	4	-	1	5
T. subcylindrica	3	1	1	6	-	11
Total	24	65	212	27	2	330

Simultáneamente se han revisado las colecciones depositadas en diversos museos y se ha recopilado y evaluado la información bibliográfica disponible sobre la materia (Martínez-Ortí y Robles, 2003).

Presentamos en este trabajo los resultados obtenidos sobre las seis especies terrestres del Superorden Caenogastropoda Cox 1960 que habitan en la Comunidad Valenciana: *Cochlostoma (Obscurella) martorelli* (Servain, 1880), *Platyla polita polita* (Hartmann, 1840), *Leonia mamillaris* (Lamarck, 1822), *Pomatias elegans* (O.F. Müller, 1774), *Tudorella sulcata sulcata* (Draparnaud, 1805) y *Truncatella subcylindrica* (Linnaeus, 1767). El estudio se completa con el análisis del registro fósil cuaternario de estas especies en el mismo ámbito geográfico.

MATERIAL Y MÉTODOS

Los puntos de muestreo cubren todo el ámbito geográfico de la Comunidad Valenciana y corresponden a hábitats muy variados: roquedos, cuevas, marjales, cultivos, etc. Las muestras examinadas, en su mayoría, proceden de la colección Martínez-Ortí, depositada en el Museu Valencià d'Història Natural de Valencia (MVHN) y aparecen reflejadas también en su tesis doctoral de 1999. Además se han revisado muestras de las colecciones Robles (Museo de Geología de la Universitat de València), Boscá y Siro de Fez (MVHN), Roselló (Museo de Ciencias Naturales de Valencia, MCNV), Aguilar-Amat, Bofill, Gasull, Martorell y Rosals (Museu de Zoologia de Barcelona, MZB) y las de Azpeitia, Hidalgo y Paz y Membiela (Museo Nacional de Ciencias Naturales de Madrid).

En total se han recopilado 330 registros cuya distribución se indica en la Tabla I. De ellos, 24 corresponden a citas bibliográficas que no han podido ser confirmadas por los autores mediante la revisión del material original. 84 se han recogido en la provincia de Castellón, 105 en la de Valencia y 141 en la de Alicante. En el listado sólo se cita el autor que señala una localidad por primera vez, excluyendo aquellos autores que repiten citas anteriores. Las muestras procedentes de localidades bibliográficas que han podido ser revisadas, al encontrarse depositadas en diversos museos españoles, se indican con (R). La posición geográfica de los puntos de muestreo se sitúa por su coordenada UTM, con precisión de 1 km para las muestras recolectadas por los autores y de 10 km para las bibliográficas. Para cada especie se recopilan las citas previas, se lista el material examinado indicando la colección a la que perte-

nece, se da a conocer su distribución geográfica en la Comunidad Valenciana, su hábitat y el estado de conservación en las especies amenazadas, así como las medidas de protección y la legislación medioambiental que les afectan.

Para la Sistemática y Nomenclatura se ha utilizado el listado proporcionado por el proyecto CLECOM I+II (Check List of European Continental Mollusca) (BANK, BOUCHET, FALKNER, GITTENBERGER, HAUSDORF, VON PROSCHWITZ Y RIPKEN, 2001; FALKNER, BANK y RIPKEN, 2001), teniéndose en cuenta las observaciones y modificaciones contenidas en BANK, FALKNER, NORDSIECK Y RIPKEN (2001) y en FALKNER, RIPKEN Y FALKNER (2002).

RESULTADOS Y DISCUSIÓN

En total, se han hallado seis especies de caenogasterópodos terrestres, pertenecientes a dos Órdenes, tres superfamilias y cuatro familias.

Familia COCHLOSTOMATIDAE Kobelt, 1802

Cochlostoma (Obscurella) martorelli (Servain, 1880) (Figs. 1, 11-13, 20)

Citas previas: ROSELLÓ (1934): Lucena (R) (YK34). GASULL (1981): Chodos (YK35). *Material inédito*: Col. MARTÍNEZ-ORTÍ: Castillo de Villamalefa. Fte. Tosca (YK2450); La Pobla de Benifassà. Font de la Canaleta (BF6205). Vistabella. Fuente coput (YK3262); Vistabella. Penyagolosa. Canaleta S (YK2555); Vistabella. Penyagolosa. Fte. Pegunta (YK2558); Xodos (=Chodos). Barranco (YK3058). Col. ROBLES: Xodos. Fte. Archivello (YK2959). Col. SIRO DE FEZ: Lucena (YK34).

Dimensiones: Macho (m): 13,2 mm hmx y 6,0 mm de Ømx; hembra (h): 14,3 mm hmx y 6,0 mm Ømx. Según GOFAS Y BACKELJAU (1994) distinguir las especies de este género resulta muy difícil, debido a su escasa diferenciación y a la tendencia a formar cada una de ellas poblaciones locales. Si bien las características de nuestros ejemplares coincidían con los que estos autores asignan a *C. martorelli*, algunos ejemplares de la fuente de la Pegunta han sido revisados por el Dr. Gofas, quien ha confirmado la asignación específica.

Aparato reproductor (Figs. 11-13): Las genitalias, de ambos sexos, de nuestros ejemplares coinciden con las descritas y figuradas por GOFAS Y BACKELJAU (1994).

Distribución geográfica (Fig. 20): Endemismo localizado preferentemente en las montañas y valles de los Pirineos orientales, franceses y españoles, con algunas localidades aisladas en las montañas de Montserrat (provincia de Barcelona) y en la provincia de Tarragona (ALTONAGA, GÓMEZ, MARTÍN, PRIETO, PUENTE Y RALLO, 1994; BOFILL Y HAAS, 1920; GASULL, 1981; GOFAS Y BACKELJAU, 1994; KERNEY Y CAMERON, 1999; RAVEN, 1990; VILELLA, 1967). En la Comunidad Valenciana se distribuye por la provincia de Castellón, en las comarcas de l'Alcalatén, el Alto Mijares y el Baix Maestrat (MARTÍNEZ-ORTÍ Y ROBLES, 2003). Las nuevas localidades amplían la distribución de esta especie en el interior de esta provincia, de donde únicamente se conocían dos localidades (GASULL, 1981; ROSELLÓ, 1934). Estos enclaves constituyen el área de distribución más meridional de esta especie.

Hábitat: Ha sido recogida en lugares de altitud superior a 800 m, en fuentes o muros y roquedos calcáreos que en general están cercanos a fuentes o arroyos. La muestra de Penyagolosa-Canaleta sur fue recogida a 1.600 m de altitud, en un roquedo que generalmente se encuentra envuelto por nieblas y donde la humedad suele ser elevada.

Conservación: Especie propuesta para su protección en la Comunidad Valenciana por MARTÍNEZ-ORTÍ Y ROBLES (2003).

Familia ACICULIDAE J.E. Gray, 1850

Platyla polita polita (Hartmann, 1840) (Figs. 2, 20)

Citas previas: FEZ (1961): Pego. San Juan (R) (YJ50). BOETERS, GITTENBERGER Y SUBAI (1989): Benirrama (= 6 km ssw Pego) (YJ40); Dénia. Cueva de Benimaquia (BD50); Jeresa (YJ32).

Material inédito: Col. Martínez-Ortí: Benialí. Benirrama. Alto del Chap (YJ4301); Benialí, ctra. a Pego km 37,5 (YJ4403); Gandia. Cova Xurra (YJ4117); Pego. Bco. de los Frailes (YJ5200); Sueras. Font de Castro (YK2424); Alzira, la Murta (V. Escutia *leg.*). Col. Siro de Fez: Dénia. Santa María del Mar (BD50).

Dimensiones: Las dimensiones máximas de las conchas estudiadas son 3,55 mm de altura y 1,25 mm de diámetro. GITTENBERGER en SEDDON Y HOLYOAK (1993) indica que los ejemplares de esta especie que viven en nuestra área de estudio presentan un tamaño relativo mayor y un ápice claramente romo, en comparación con los de Europa central.

Distribución geográfica (Fig. 20): Especie paleártica atlántico-mediterránea occidental y europea, distribuida por varios países mediterráneos: N de África, España, Francia, S de Italia y Sicilia y centroeuropeos hasta el N de Rusia (BOETERS *ET AL.*, 1989; GASULL, 1975; GITTENBERGER, 1990, 1991; KERNEY, CAMERON Y JUNGBLUTH, 1983; SEDDON Y HOLYOAK, 1993; SHIKOV, 1984). Las localidades valencianas son las únicas conocidas en la Península Ibérica y quedan muy alejadas de otros enclaves europeos (BOETERS *ET AL.*, 1989; PRIETO, MARTÍN Y GÓMEZ, 1887; PRIETO, MARTÍN, GÓMEZ Y LARRAZ, 1986). Se localizan en las tres provincias de la Comunidad Valenciana, en la de Castellón en la comarca de la Plana Alta, en la de Valencia en la Safor y en la Ribera Alta y en Alicante en la Marina Alta (MARTÍNEZ-ORTÍ Y ROBLES, 2003).

Hábitat: No se ha encontrado ningún ejemplar vivo. Las conchas estudiadas se han localizado en cuevas y en la base de roquedos, tamizando gran cantidad de tierra (MARTÍNEZ-ORTÍ Y ROBLES, 2003).

Conservación: Especie propuesta para su protección en la Comunidad Valenciana por MARTÍNEZ-ORTÍ Y ROBLES (2003).

Familia POMATIIDAE Newton, 1891

Leonia mamillaris (Lamarck, 1822) (Figs. 3, 14, 15, 20)

Citas previas: ROSSMÄSSLER (1853): Alicante (=Alacant) (YH24). HIDALGO (1870): Alicante (R). MARTORELL Y BOFILL (1888): Alicante (R). SAINT-SIMON (1891): Orihuela (XH81). ROSELLÓ (1910): Alicante (R). BOFILL Y AGUILAR-AMAT (1924): Hifac (R) (BC48). PICARD (1949): Alicante. GASULL (1975): Alicante. Cap Huertas (R) (YH24); Alicante. Castillo Santa Bárbara (YH24); Alicante. Ctra. a Elche km 73 (R) (YH14); Aspe. Ctra. Elche km 3 (R) (XH94); Benidorm. Sierra Helada (R) (YH57); Benijófar (R) (XH91); Campoamor (R) (XG99); Crevillente (R) (XH93); Elche. Pantano Vinalopó (R) (XH94); Faro de Santa Pola (R) (YH13); Ifac. Peñón; Orihuela. Castillo (R) (XH81); Pinet. Ctra. Elche (R) (YH02); Santa Pola. Ctra. Faro (R) (YH13); Torrevieja (YH00). IBÁÑEZ Y ALONSO (1980): Benidorm. Cayola (YH47); Carretera de Santa Pola a Elche (YH03); Cuevas de Canalobre (YH26); Punta de Llomarit (YH25); vía férrea al oeste de la estación de Benidorm. Barranco de la Tapia (YH46). FRANK (1987): La Marina (YH02). TALAVÁN Y TALAVÁN (2004): Islote de Benidorm (YH56).

Material inédito: Col. Azpeitia: Alicante; La Vila Joiosa (YH46); Orihuela. Col. Bofill: Alicante; Valencia. Col. Boscá: Alicante. Col. Martínez-Ortí: Aguas de Busot. Balneario (YH2965); Alacant, ctra. a Elx km 4 (YH1343); Alacant. El Arenal. Ermita Ntra. Sª. Rosario (YH1733); Alacant. El Arenal. Playa (YH1640); Alacant. Serra de Fontcalent (YH1047); Alacant. Tánger, cementerio (YH2054); Alacant. Villafranqueza, a 1 km (YH2054); Albatera. Monte Alto (XH8135); Calp. Penyal d'Ifac

(BC4580); Campello, ctra. a Alacant. Fábrica de Balaustres (YH2858); Crevillent. Entrada desde Elx (XH9236); Elx. L'Altet (YH1539); Guardamar. El Moncayo (YH0517); La Vila Joiosa. Embalse de Amadorio (YH3969); La Vila Joiosa. Casas del Cojo (YH3768); La Vila Joiosa, ctra. a Relleu km 4,1 (YH4069); La Vila Joiosa. Plà Caldereta (YH3463); Monforte del Cid. Casas de Bautista (YH0546); Orihuela. Barranco (Bco.) de la Cañada de la Estaca (XG9196); Orihuela. Bco. al N del bco. de la Cañada de la Estaca (XH9901); Orihuela. Bco. al S del bco. de la Cañada de la Estaca (XH9900); Orihuela. Cabezo la Pedrera (XH8511); Orihuela. Puerto de Rebate, km 20 (XH8603); Orihuela. Rincón de Bonanza (XH7718); Orihuela. Torremendo (XH8707); Pilar de la Horadada. Cañada de Matamoros (XG9597); Pilar de la Horadada, ctra. a Rebate km 23 (XH8600); Pilar de la Horadada, ctra. a Rebate km 24 (XG9493); Pilar de la Horadada. Dehesa de Campoamor (XG9898); Pilar de la Horadada. Paraje natural Río Seco (XG9196); Pilar de la Horadada. Pueblo (XG9597); Santa Pola. Cap de Santa Pola. Faro (YH1732); Torrevieja. Barranco (YH0508); Torrevieja. Urbanización Los Balcones (XH9804). Col. Siro de Fez: Altea (YH57); Alicante. Camino del Castillo; Santa Pola. Cap de Santa Pola (YH13); Valencia.

Observaciones: Teniendo en cuenta la distribución de esta especie, creemos que la localidad de las muestras nº80-1105 (MZB) y nº354 (MVHN), "Valencia", no debe corresponder a la localidad de recolección, sino que debe referirse a la Comunidad Valenciana en general.

Dimensiones: Las medidas han sido realizadas sobre 31 ejemplares recogidos vivos (13 m y 18 h). M: 17,1-15,7 mm h y 10,3-9,1 mm Ømx; h: 20,0-17,4 mm h y 12,0-11,6 mm Ømx. Se aprecia un claro dimorfismo sexual, en el que las hembras presentan, en general, mayor tamaño que los machos, coincidiendo con los datos obtenidos por ALONSO E IBÁÑEZ (1980) e IBÁÑEZ Y ALONSO (1980) de la población de Bolnuevo (Almería).

Aparato reproductor (Figs. 14, 15): La morfología de las genitalias de los ejemplares estudiados, de ambos sexos, coinciden con las descritas y figuradas por ALONSO E IBÁÑEZ (1980) e IBÁÑEZ Y ALONSO (1980).

Distribución geográfica (Fig. 20): Especie Ibero-nordafricana que se presenta en el Norte de África desde la zona oriental del Rif (Marruecos) a Orán (Argelia) y en la Península Ibérica se conoce en las provincias de Alicante, Murcia, Almería (ALONSO E IBÁÑEZ, 1980; GASULL, 1972, 1975; GIUSTI Y MANGANELLI, 1984; IBÁÑEZ Y ALONSO, 1980; MERMOD, 1952; PICARD, 1949; SACCHI, 1957; SACCHI Y NOS, 1958) y de Punta de la Mona, La Herradura en Almuñecar (UTM=30SVF5271) y que corresponde a la primera cita de esta especie para la provincia de Granada. Según SACCHI (1957) e IBÁÑEZ Y ALONSO (1980) esta distribución podría indicar una posible conexión terciaria entre la región bética de la Península Ibérica y el Rif (N de Marruecos). En la Comunidad Valenciana vive en la provincia de Alicante en las comarcas de la Marina Baixa, l'Alacantí, el Vinalopó Mitjà, el Baix Vinalopó y la Vega Baja.

Hábitat: Especie asociada a suelos calcáreos y pedregosos (GASULL, 1975; IBÁÑEZ Y ALONSO, 1980). Ha sido encontrada en este tipo de suelos ligada a pinares y matorral mediterráneo, hasta una altura máxima de 600 m. Ha sido recogida viva en 14 localidades. Habita junto a *Tudorella s. sulcata* o a *Pomatias elegans* en varias localidades. GASULL (1972) la encuentra junto a ejemplares fósiles de *T. s. sulcata* en Almería.

Pomatias elegans (O.F. Müller, 1774) (Figs. 4, 16, 17, 21)

Citas previas: HIDALGO (1871): Játiva (YJ11); Peñíscola (R) (BE77); Valencia (R) (YJ27). ROSELLÓ (1910): Valencia (R). PARDO (1920): Valencia. BOFILL Y AGUILAR-AMAT (1924): Cim del Mondúber (R) (YJ32). La Barraca de Valldigna. Bco. de la Falzía (R) (YJ23). Mascarat (R) (BC38). Montgó (R) (BC59). Sogorb (R) (YK11). Xeresa (YJ42). FEZ (1961): Pego. San Juan (R) (YJ50). MADURGA (1973): Gandia. Ca-

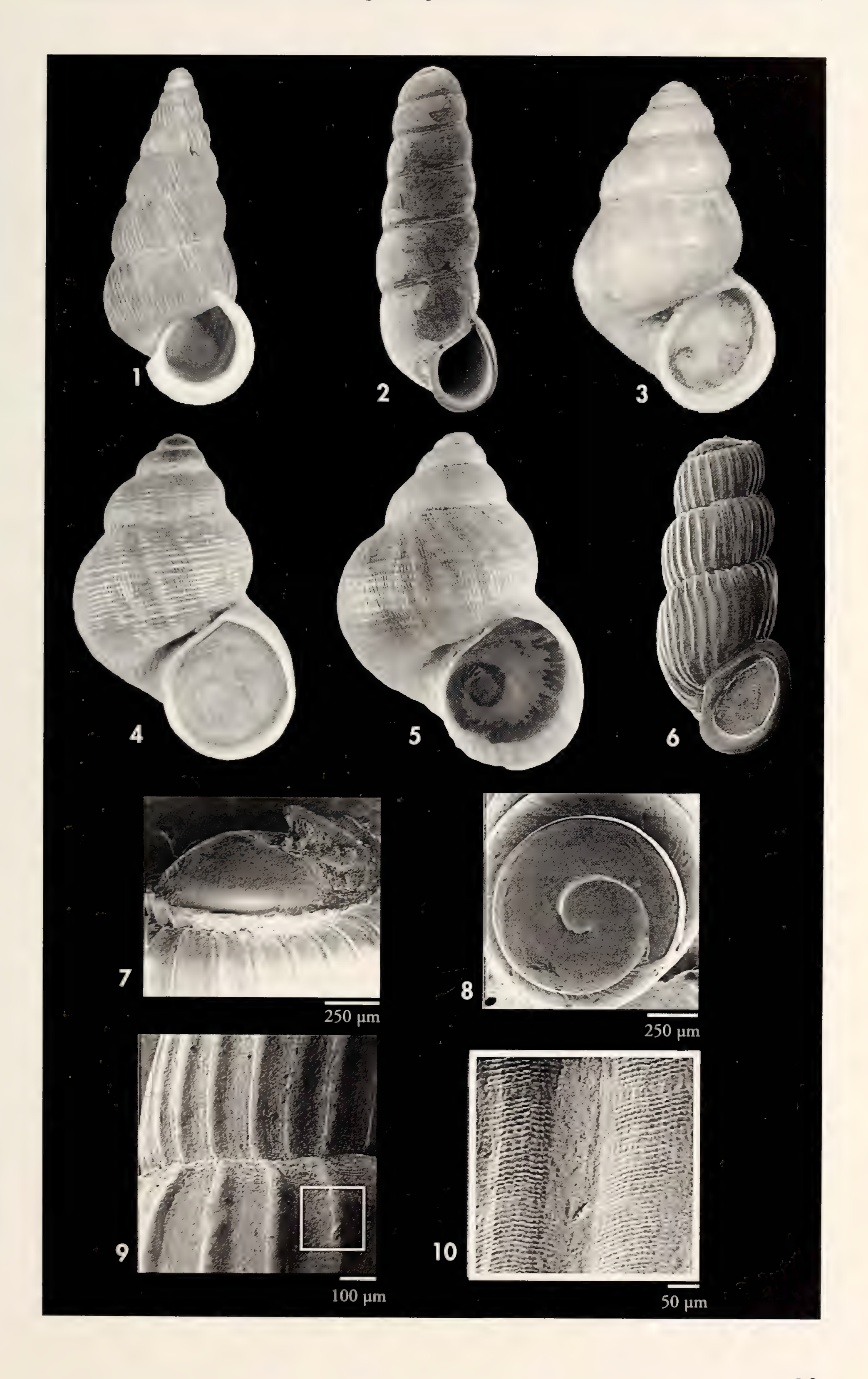
verna del Parpalló (fósil) (V-YJ42). GASULL (1975): Ayora. Acequia Les Chichiles (R) (XJ62); Banyeres. Río (R) (YH08). Benidoleig. Cova les Calaveres (R) (YH59). Buñol. Cueva de Turche (R) (XJ86). Callosa d'Ensarriá. El Algar (R) (YH58). Cerdà. Acequia de Ranes (R) (YJ11); Corbera d'Alzira. Les Fontanelles (R) (YJ24). Dénia. Montgó (R) (BC59). Gandía. Mondúber (R) (YJ32). Garganta de Gata (R) (BC49). Ifac. Peñon (R) (BC48). Jarafuel (R) (XJ63). Játiva. Acequia La Murta (La Vila) (R) (YJ11). Játiva. Alboy (YJ11); Játiva. Castillo (R) (YJ11). Jeresa. Les Cingles (R) (YJ32); La Nucia. La Favara (R) (YH57). Montaverner. Río Clariano (R) (YJ10); Ontinyent. Pous Clars (R) (YH09); Pego. El Bodoix (YJ50). Pego. San Juan (R) (YJ50). Tabernes de Valldigna. Monte Umbría (R) (YJ32); Vallada. Castillo (R) (YJ00); GASULL (1981): Campos de Arenoso (R) (YK04); La Jana (R) (BE68); Lucena del Cid. Bco. (R) (YK34); Lucena del Cid. Huertos (R) (YK34); Montanejos (R) (YK13). Montanejos. Cueva Negra (R) (YK13); Montanejos. La Alquería (R) (YK13); Navajas. Fte. la Luz (R) (YK11); Viver. Fte. San Miguel (R) (YK02). FRANK (1987): La Marina, (YH02). ROBLES (1991): Islas Columbretes (fósil) (CE01). ALTONAGA *ET AL.* (1994): Castelló de Rugat (YJ20); Peñón de Ifach (BC48); Ayelo de Rugat (YJ30); Xátiva: castillo (YJ11). HERRERO-BORGOÑÓN Y GONZÁLEZ (1993): Palma de Gandia. Cova del Blanquissal (YJ41).

Observaciones: GASULL (1975) publica la localidad: "Játiva. Acequia de la Murta". Sin embargo en la etiqueta aparece: "Játiva. Acequia de la Vila". Creemos que se trata de un error de trascripción, siendo válida la localidad indicada en la etiqueta.

Material inédito: Col. Hidalgo: Ollería (YJ11); Orihuela (XH81). Col. Martínez-Ortí: Adzaneta del Maestrat, cueva oscura (YK3753); Agres, cruce río Agres-FFCC (YH1696); Aín. Bco. de la Caridad (YK2719); Aín. Cueva del Gat (YK2820); Alacant. El Arenal. Playa (YH1740); Alcalà de Xivert. Corral de Capellanes (BE6862); Alcalalí. Llosa de Camatxo (YH5995); Alcoi. Parc Natural la Font Roja. Pico Menejador (YH1482); Almedíjar. Collado del Cañar (YK2116); Alzira. La Murta (YJ2834); Argelita. Bco. a 1 km (YK2539); Artana. Bco. de Castro (YK3519); Banyeres, cruce ctras. (YH0189); Benafer. Bco. de Carlos (YK0227); Benasal. Balneario (YK4372); Bicorp, ctra. a Quesa km 11 (XJ9233); Càlig. Bco. Río Seco (BE7782); Benasal. Piscina municipal (YK4272); Benialí. Benirrama (YJ4403); Benialí. Benirrama. Alto del Chap (YJ4301); Benialí, ctra. a Pego, km 37,5 (YJ4403); Benichembla, río Xalò (YH5193); Benimaurell (YH4995); Bejís. Fte. los Cloticos (XK9322); Borriol. Río Seco. Puente (YK4935); Càlig. Salida (BE7582); Callosa d'Ensarrià. Bolulla (YH5185); Callosa d'Ensarrià. Río Guadalest (YH5080); Calp. Parc Natural del

(Página derecha) 1. *Cochlostoma martorelli* (Servain, 1880) (hembra), Vistavella, fuente coput (Castellón) (12,86 mm h). 2. *Platyla polita polita* (Hartmann, 1840), Beniali, ctra. a Pego km 37,5 (3,5 mm h). 3. *Leonia mamillaris* (Lamarck, 1822) (macho), Pilar de la Horadada, pueblo (Alicante) (16,5 mm h). 4. *Pomatias elegans* (O.F. Müller, 1774) (macho), L'Alcudia de Veo, camino rural (Castellón) (14,6 mm h). 5. *Tudorella sulcata sulcata* (Draparnaud, 1805) (hembra), Orihuela, barranco al N del barranco de la Cañada de la Estaca (Alicante) (20,78 mm h), 6-10. Ejemplar adulto de *Truncatella subcylindrica* (Linnaeus, 1767), Valencia, puerto (MVHN nº817) (4,7 mm h). 6: vista frontal; 7, 8: vista apical; 9, 10: detalles de la ornamentación.

(Right page) 1. Cochlostoma martorelli *(Servain, 1880) (female), Vistavella, coput spring (Castellón) (12.86 mm h). 2.* Platyla polita polita *(Hartmann, 1840), Beniali, road to Pego km 37.5 (3.5 mm h). 3.* Leonia mamillaris *(Lamarck, 1822) (male), Pilar de la Horadada, village (Alicante) (16.5 mm h). 4.* Pomatias elegans *(O.F. Müller, 1774) (male), L'Alcudia de Veo, country lane (Castellón) (14.6 mm h). 5.* Tudorella sulcata sulcata *(Draparnaud, 1805) (female), Orihuela, the gully north of the gully of la Cañada de la Estaca (Alicante) (20.78 mm h). 6-10. Adult specimen of* Truncatella subcylindrica *(Linnaeus, 1767), Valencia, port (MVHN nº817) (4.7 mm h). 6: front view; 7, 8: apical view; 9, 10: details of the sculpture.*


1
2
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4
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6
7
250 µm
8
250 µm
9
100 µm
10
50 µm

Penyal d'Ifac (BC4580); Carretera La Jana-Canet lo Roig km 2 (BE6690); Carretera La Cènia-Traiguera. Bco. de la Cova Alta (BE7294); Castellnovo. Fte. Marjalet (YK1816); Castelló de Rugat. Collado del Raconet (YJ2802); Castillo de Villamalefa. Fte. Tosca (YK2450); Chelva. Fte. Berra (XK7000); Chelva. Puente del Reatillo (XK7101); Chera. Finca la Ermita (XJ7244); Chulilla. Fte. de la Rinconada (XJ8289); Corbera d'Alzira. Cova Negra (YJ2935); Coves de Vinromá. Font del Molinet (BE5772); Domeño. Bco. del Agua (XJ7897); Domeño. Baños de Verche (XJ7897); Dos Aguas. Fte. de San José (XJ8951); Dos Aguas. Bco. del Bosque (XJ8955); Enguera, camino a Casa Perereta (XJ9312); Enguera, ctra. a Ayora km 2 (XJ9915); Estivella. Fte. de Barraix (YJ2397); Fanzara. 2,1 km a la Cueva de la Mola desde ctra. (YK2930); Fondeguilla. Bco. San Juan (YK3312); Fuentes de Ayodar. Bco. de Ayodar (YK2033); Gátova. Los Costales (YK0906); Gestalgar. Fte. de la Peña María (XJ8486); Gestalgar. Fte. los Morenillos (XJ8485); Jarafuel. Fte. de las Anguilas (XJ6633); L'Alcudia de Veo. Camino rural (YK2125); L'Alcudia de Veo. Pantano de Benitandús (YK2723); L'Alcudia de Veo. Racó San Francés (YK2924); La Pobla de Benifassà. Ballestar. Fte. Ballestar (BF6005); La Pobla de Benifassà. Convent (BF6306); La Pobla de Benifassà. Font de la Canaleta (BF6205); La Pobla de Benifassà. Fredes. Bco. del Salt (BF6210); La Pobla de Benifassà. Font de Sant Pere (BF6805); La Pobla de Benifassà. Fredes. Fuente la Roca (BF6010); La Pobla de Benifassà. Fredes. Font del Teix (BF6110); La Pobla de Benifassà. Molí del Abad (BF6705); La Pobla de Benifassà. Presa (BF6606); La Pobla del Duc. Bco. de Sara (YJ2307); La Vila Joiosa. Plà Caldereta (YH3463); L'Orxa. Río Serpis (YJ3202); Millares. Alto de la Cuesta (XJ9344); Millares. Bco. del Hondo (XJ9245); Moixent. Bco. en el pueblo (XJ9405); Moixent. Pozo San Juan (XJ9703); Montanejos. Bco. de la Maimona (YK0938); Morella. Fábrica de Giner. Río Bergantes (YL4200); Morella. Puerto de Torremiró, km 74 (YL4706); Navarrés. Fte. del Río (XJ9327); Olocau. Bco. de Pedralvilla (YJ1494); Ontinyent, ctra. a Fontanars km 9 (YH0196); Ontinyent. Fte. de la Morera (YH0096); Orba. Campell. Cruce ctra. a Orba (YH5397); Orba, ctra. a Vall de Laguar km 3 (YH5397); Ortells. Bco. de la Juncosa (YL3910); Parcent. Coll de rates (YH5590); Pego. Bco. de los Frailes (YJ5200); Pego, ctra. a Alcalá. Barranco (YH4499); Pego. Frente finca San Juan (YJ5101); Polop. Entrada (YH5075); Quatretonda, barranco (YJ2719); Quesa. Río Grande (XJ9129); Relleu. Río Amadorio (YH3473); Rosell. Molí de Malany (BF6903); San Antonio de Benagéber. La Hoya Somera (XK6400); San Rafael del Río. Masia de Canet (BE7399); Segorbe. Río Palancia (YK1614); Serra. Fte. del Berro (YJ1698); Serra. La Caseta del Retor. Bco. Saraguillo (YJ1497); Siete Aguas. Cueva Alta (XJ8370); Siete Aguas. Ventamina (XJ8369); Simat, ctra. a Barx (YJ3323); Sinarcas. Cueva de los Castillejos (XK5703); Sot de Chera. Fte. Masalucas (XJ7988); Sot de Ferrer. Río Palancia. Puente nuevo (YK2109); Sueras. Manantial de Castro (YK2424); Sumacàrcer. Font la Teula (YJ0429); Tales, cruce de ctras. (YK2925); Tàrbena, ctra. km 28 (YH5288); Tàrbena, ctra. a Callosa km 34 (YH5286); Tàrbena. Umbría de Ferrer (YH5387); Teresa de Viver. Bco. Uredilla (XK9918); Teulada. Ermita de San Vicente (BC5089); Titaguas. Campamento del Molino Quemado (XK5616); Todolella. Bco. de Todolella (YL3203); Torre Lloris. Río Albaida (YJ1723); Torrent. Depósito de agua (YJ1768); Traiguera. Bco. de Barranquet (BE7289); Vall d'Almonacid. Río Chico (YK1617); Vall d'Ebo, a 1,5 km (YH4599); Vall d'Ebo, ctra. a Pego km 2 (YJ5001); Vallibona. Fte. de las Rocas (BE4697); Vallibona. Fte. Sta. Águeda (BE4897); Vallibona. Les Moles (BE4997); Vallibona. Masia de la Torre (BE5199); Vilafamés. Font del Lleó (YK5042); Villahermosa del Río. Bco. del Regajo (YK1753); Villar del Arzobispo. Corral del Mosén (XK8702); Vistabella. Fte. Coput (YK3262); Viver. Fte. de la Salud (YK0521); Venta la Higuera. Rambla San Mateo (BE5774); Vinaròs. Playa del Surrac (BE8278); Vistabella. Fte. de la Pegunta (YK2558); Xà-

bia. Cala Blanca (BC5794); Xàbia. Cap de Sant Antoni (BC5698); Xàbia, ctra. a Dénia km 1,5 (BC5398); Xàbia, ctra. al Cap de la Nau (BC5694); Xàbia. Platja del Portitxol (BC5893); Xàtiva. Penya San Diego (YJ1216); Xeresa. Bco. de Xeresa (YJ3920); Xert. Bco. de la Fuente (BE6088); Xixona. Río Torremanzanas (YH1867); Yátova. Entre cola del pantano y ctra. (XJ7959); Yátova. Mijares. Fte. Ntra. Sra. Desamparados (XJ7661); Yátova. Río Mijares. Puente (XJ7661); Zorita. La Balma (YL3814); Zorita. Molino de Villar (YL4016). Col. MZB: Anna (YJ02); Hifac (BC48). Col. Robles: Anna. Cerca de la Albufera (YJ0320); Benafer. Fte. de los Nogales (YK0723); Campell. Vall Laguart, ctra. al río (2 km) (YH5196); Canet lo Roig. Font de la Roca (BE6691); Fanzara. Fuente de l'Alcudia (YK2832); Islas Columbretes (fósil, CE0219); La Pobla de Benifassà. Font del Convent (BF6306); Navajas. Fte. de la (YK1317); Ribarroja. Fte. la Cisterna (YJ0980); Rossell. Font del Baix (BF6400); Salzedella. Fte. Ciurana (BE5974); Sarratella. Font del Torrent (BE4766); Sot de Chera. Río Reatillo (XJ7887); Teresa de Cofrentes (XJ6830); Vallibona. Font del Fou (BE5899); Vilanova d'Alcolea. Font de la Vila (BE5057). Col. Siro de Fez: La Barraca de Aigues Vives (YJ2830); Portaceli (YJ19); Valencia.

Dimensiones: M: 17,1 mm hmx; 11,9 mm Ømx; h: 18,5 mm hmx; 12,9 mm Ømx.

Las medidas realizadas sobre las conchas de ejemplares recogidos vivos de ambos sexos indican que, aunque las hembras pueden llegar a ser un poco mayores que los machos, no se puede observar un claro dimorfismo sexual.

Aparato reproductor (Figs. 16, 17): La morfología de las genitalias, de ambos sexos, de nuestros ejemplares coinciden con las descripciones y figuras de CREEK (1951), ALONSO E IBÁÑEZ (1977) y GIUSTI *ET AL.* (1995).

Distribución geográfica (Fig. 21): Especie europea, atlántico-mediterránea occidental y centroeuropa (ADAM, 1960; ALONSO E IBÁNEZ, 1977; ALTONAGA *ET AL.*, 1994; GITTENBERGER, BACKHUYS Y RIPKEN, 1984; GROSSU, 1986; KERNEY *ET AL.*, 1983). Esta distribución puede venir condicionada por su intolerancia a los inviernos fríos, lo que hace que presente su límite septentrional a lo largo de una línea que sigue la isoterma de 2 °C en el mes de enero (KILLEEN, 1992).

En la Península Ibérica se distribuye por el área central de Portugal, la Cornisa Cantábrica desde Galicia hasta el País Vasco, Navarra, Valle del Ebro hasta los Pirineos y por el Mediterráneo se extiende por las Islas Baleares e Islas Medas y por el continente desde Cataluña hasta Murcia (ALONSO E IBÁÑEZ, 1977; ALTIMIRA, 1969; ALTIMIRA Y ALTABA, 1984; ALTONAGA *ET AL.*, 1994; ANGULO Y MARTÍN, 1985; CASTILLEJO, 1981; FACI, 1991; GASULL, 1974, 1975; IBÁÑEZ Y ALONSO, 1980; LARRAZ Y EQUISOAÍN, 1993; NOBRE, 1941; PICARD, 1949). Recientemente han sido halladas dos poblaciones en la provincia de Málaga: Barranco de la Coladilla (UTM= 30SVF2468) y en el Río de la Miel (UTM= 30SVF2768), ambas en Nerja, que constituyen las primeras citas para Andalucía. Sería necesario realizar más muestreos en la región para confirmar que no se trata de introducciones antrópicas. En Aragón se distribuye preferentemente por el pre-pirineo, evita la depresión del Ebro en la zona de los Monegros y aparece en la Meseta Ibérica (FACI, 1991). En la Comunidad Valenciana se distribuye ampliamente por las provincias de Castellón en todas sus comarcas, Valencia, donde falta únicamente en la comarca del Rincón de Ademuz, y Alicante, donde se conoce de las comarcas del Comtat, la Marina Alta y la Baixa, l'Alcoià, l'Alacantí y la Vega Baja. Ha sido citada en las Islas Columbretes, donde ROBLES (1991) señala que esta especie debe darse como extinguida, tras los numerosos muestreos realizados en los que únicamente se han encontrado conchas. Los ejemplares fósiles han sido datados del último glaciar (-17.000 años).

Hábitat: Es una especie humícola, detritícola y calcícola (ADAM, 1960; ALTONAGA *ET AL.*, 1994; GASULL, 1975, 1981; GIUSTI *ET AL.*, 1995; IBÁÑEZ Y ALONSO, 1980). Ha sido recolectada en

ambientes de pinada, matorral mediterráneo y también, aunque en menor medida, en encinares, riberas, arroyos y cultivos. Se halló viva en 47 localidades. Los ejemplares estaban escondidos debajo de piedras, mantillo o en la base del matorral, donde la humedad era más abundante y, en general, se presentaban en colonias. Estos datos coinciden con los de FACI (1991) y LARRAZ Y EQUISOAÍN (1993). Se han encontrado ejemplares superando los 1.300 m de altitud tanto en la provincia de Alicante como en la de Castellón. FACI (1991) indica que sus muestras fueron recolectadas entre 300 y 1.000 m y añade que MERMOD no encontró esta especie en Suiza en alturas superiores a 1.000 m.

Tudorella sulcata sulcata (Draparnaud, 1805) (Figs. 5, 18, 19, 22; Tabla II)

Comentarios taxonómicos: T. s. sulcata ha sido, frecuentemente, denominada como *Pomatias sulcatus*; sin embargo FALKNER *ET AL.* (2002), basándose en el trabajo de VITTURI, CATALANO Y MACALUSO (1986), asignan esta especie al género *Tudorella* P. Fischer, 1885.

Citas previas: ROBLES Y MARTÍNEZ-ORTÍ (1995): La Cañada de la Estaca, A-XG99; Pilar de la Horadada. Paraje natural de Río Seco, A-XH90.

Material inédito: Col. Martínez-Ortí: Orihuela. Barranco al N del Barranco de la Estaca (XH9901); Orihuela. Barranco al S del Barranco de la Estaca (XH9900). Col. Robles: Bacarot (fósil, YH1446).

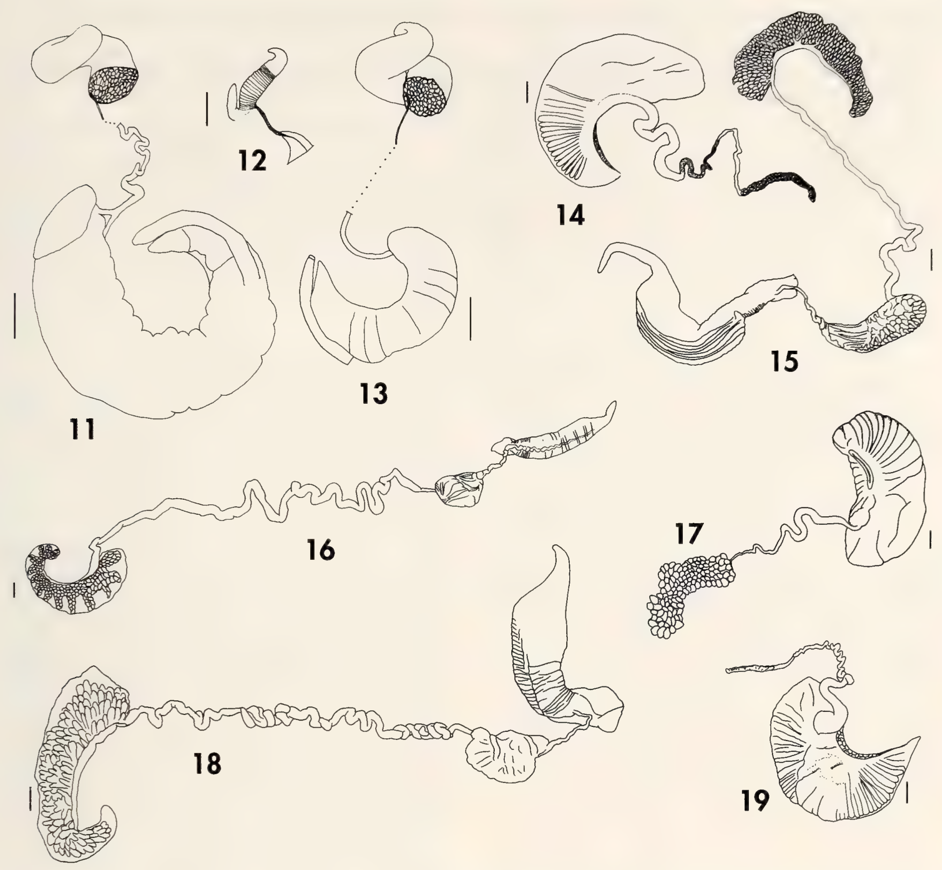
Dimensiones: Esta especie presenta un claro dimorfismo sexual, con las hembras de tamaño generalmente superior al de los machos. En la Tabla II queda patente esta característica, de acuerdo con las medidas de una muestra de 73 individuos adultos recogidos vivos en la localidad del barranco al norte del barranco de la Cañada de la Estaca (Orihuela).

Aparato reproductor (Figs. 18, 19): La morfología de las genitalias, de ambos sexos, que han sido recolectados en Alicante coincide con las descritas y figuradas por IBÁÑEZ Y ALONSO (1978, 1980) y GIUSTI *ET AL.* (1995).

Distribución geográfica (Fig. 22): *Tudorella s. sulcata* es una especie de distribución mediterránea occidental: SE de Francia, Córcega, Cerdeña, Sicilia, Malta y El Maghreb (FECHTER Y FALKNER, 1993; GIUSTI Y MANGANELLI, 1984; GIUSTI *ET AL.*, 1995; HAAS, 1929; IBÁÑEZ Y ALONSO, 1978, 1980; KERNEY Y CAMERON, 1999; KERNEY *ET AL.*, 1983; NOBRE, 1941; PAVÓN, 2005, en prensa). En la Comunidad Valenciana se han encontrado cuatro poblaciones actuales en la Vega Baja, en el sur de la provincia de Alicante (MARTÍNEZ-ORTÍ Y ROBLES, 2003; ROBLES Y MARTÍNEZ-ORTÍ, 1995) y una fósil atribuida al Pleistoceno inferior.

En la Península Ibérica, además de las localidades valencianas, *T. s. sulcata* vive en otras dos localidades, en el Algarve (sur de Portugal) y en Motril (Granada) (IBÁÑEZ Y ALONSO, 1978; NOBRE, 1941). Los autores han constatado la existencia de individuos vivos en ambas localidades en Enero de 2005. La distribución de esta especie en yacimientos plio-cuaternarios es más amplia: Palau Sacosta (provincia de Gerona) (BOFILL *ET AL.*, 1921; GASULL, 1972; HAAS, 1929; SACCHI, 1957), La Pita Calataray y San Juan de Terreros (provincia de Almería) (IBÁÑEZ Y ALONSO, 1978), Casas del Rincón (provincia de Albacete) (ALBERDI, ARIAS, BIGAZZI, BONADONNA, LEONE, LÓPEZ, MICHAUX, MORALES, ROBLES Y SORIA, 1982), Cañada de Murcia (provincia de Granada), Sierra de Quibas (Abanilla, provincia de Murcia) (ROBLES, 1989; ROBLES Y MARTÍNEZ-ORTÍ, 1995) y Bacarot (Alicante). La edad de tres de los yacimientos es conocida, ya que se encontraron mamíferos fósiles: Casas del Rincón es del Plioceno terminal y Cañada de Murcia y Sierra de Quibas son del Pleistoceno inferior. Bacarot puede correlacionarse con Quibas. El yacimiento de Palau Sacosta ha sido atribuido al "Cuaternario antiguo" (GASULL, 1972). La edad de los yacimientos de Almería es pleistocena, sin que sea posible precisarla más.

La comparación de la distribución de esta especie en el Plioceno terminal y



Figuras 11-19. Aparatos reproductores. 11-13. *Cochlostoma (Obscurella) martorelli* (Servain, 1880), Vistavella, Penyagolosa, fuente de la Pegunta (Castellón). 11: genitalia de una hembra; 12: genitalia de un macho; 13: detalle del pene. 14, 15. *Leonia mamillaris* (Lamarck, 1822), Pilar de la Horadada, dehesa de Campoamor (Alicante). 14: genitalia de una hembra; 15: genitalia de un macho. 16, 17. *Pomatias elegans* (O.F. Müller, 1774), L'Alcudia de Veo, camino rural (Castellón). 16: genitalia de un macho; 17: genitalia de una hembra. 18, 19. *Tudorella sulcata sulcata* (Draparnaud, 1805), barranco al N del Barranco de la Cañada de la Estaca (Orihuela, Alicante). 18: genitalia de un macho; 19: genitalia de una hembra. Escalas, 1 mm.

Figures 11-19. Reproductive systems. 11-13. Cochlostoma (Obscurella) martorelli (Servain, 1880), Vistavella, Penyagolosa, Pegunta spring (Castellón). 11: female genitalia; 12: male genitalia; 13: detail of the penis. 14, 15. Leonia mamillaris (Lamarck, 1822), Pilar de la Horadada, dehesa de Campoamor (Alicante). 14: female genitalia; 15: male genitalia. 16, 17. Pomatias elegans (O.F. Müller, 1774), L'Alcudia de Veo, country lane (Castellón). 16: male genitalia; 17: female genitalia. 18, 19. Tudorella sulcata sulcata (Draparnaud, 1805), the gully north of the gully of la Cañada de la Estaca (Orihuela, Alicante). 18: male genitalia; 19: female genitalia. Scale bars, 1 mm.

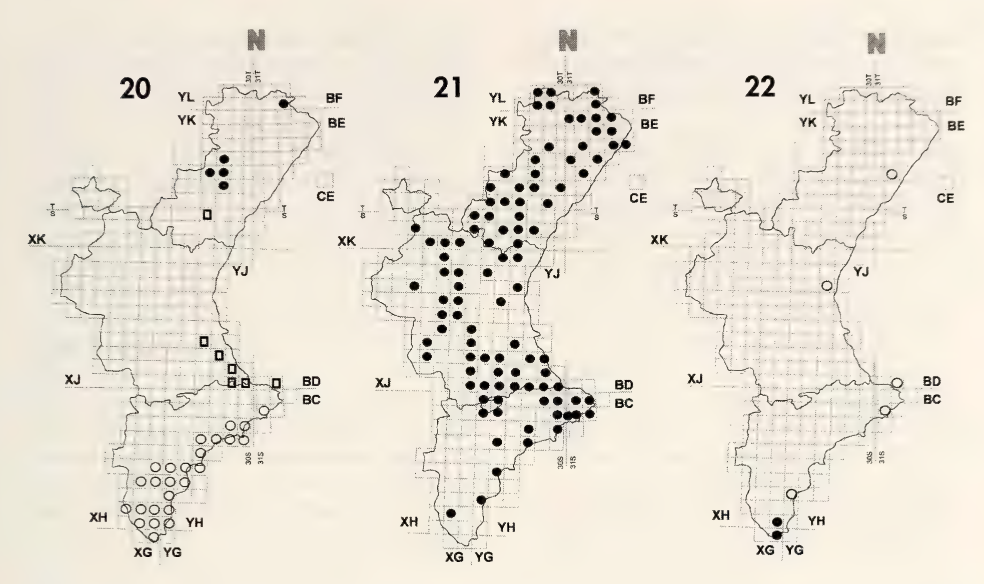
el Pleistoceno inferior con la distribución actual, permite asignar a los enclaves actuales un carácter relicto. Su posición en las proximidades del mar, frente a la amplia distribución en el interior de la península de los yacimientos pliocuaternarios, parece indicar un retraimiento a refugios cálidos de su área original de distribución, debida a los episodios fríos del Cuaternario.

Tabla II. Dimensiones de *Tudorella sulcata sulcata*. Ejemplares procedentes del barranco al N del Barranco de la Estaca (Orihuela, Alicante).
Table II. Shell measurements of Tudorella sulcata sulcata. *Specimens proceeding from the gully North of the gully of la Cañada de la Estaca (Orihuela, Alicante).*

T. sulcata sulcata n= 73		Altura máx - $\overline{x}$ - min	σ_{n-1}	Diámetro máx - $\overline{x}$ - min	σ_{n-1}
Hembras	30	23,23 - 19,66 - 17,75	1,15	16,39 - 14,34 - 12,61	0,79
Machos	43	18,98 - 17,11 - 15,55	0,81	14,65 - 12,69 - 11,42	0,54

Hábitat: Vive en ambientes similares a *Leonia mamillaris*, con la que se ha encontrado conviviendo en la Comunidad Valenciana. Las poblaciones ibéricas viven en áreas cercanas a la costa y a una altitud que no supera los 100 m. Las poblaciones alicantinas viven sobre suelos calcáreos y pedregosos ligados a pinares de *Pinus halepensis* (pino carrasco) y matorrales termomediterráneos y pre-estépicos, con especies como *Chamaerops humilis* (margalló o palmito), *Pistacia lentiscus* (lentisco) y *Stipa tenacissima* (esparto), entre la pinocha, en la base de los tallos y debajo de las piedras (MARTÍNEZ-ORTÍ Y ROBLES, 2003). Concretamente el barranco de la Cañada de la Estaca presenta como matorral dominante el *Sideritido-Helianthemetum caput-felicis*, cuyas especies prioritarias son *Helianthemum caput-felis*, *Sideritis murgetana* subsp. *littoralis* y *Thymus hyemalis* (DOCV, 3505/ 28/05/1999). Las otras dos poblaciones ibéricas, la portuguesa y la granadina, se han encontrado en la base de la vegetación de la cual probablemente también se alimenta: *P. lentiscus*, *Rhamnus lycioides* (espino negro), *Foeniculum vulgare* (hinojo) y *Genista* sp., en la primera y de *Ch. humilis*, tal y como señalan IBÁÑEZ Y ALONSO (1978), y *Maytenus senegalensis subsp. europaeus* (espino cambrón) en la segunda.

Conservación: La localidad del barranco de la Cañada de la Estaca y los barrancos al norte y al sur, en la comarca de La Vega Baja, están siendo actualmente urbanizados (MARTÍNEZ-ORTÍ Y ROBLES, 2003). En un esfuerzo por garantizar su conservación se trasladaron 50 ejemplares a otra localidad cercana al Cabo de Santa Pola en 1996 y cuyos terrenos pertenecen a la Generalitat Valenciana (MARTÍNEZ-ORTÍ Y ROBLES, 2003). Tras examinar nuevamente esta localidad, en Junio de 1999, se observó la presencia de algunos machos y hembras vivos, lo que permite albergar esperanzas de su supervivencia en la provincia de Alicante. En la otra localidad alicantina, "Pilar de la Horadada. Paraje natural Río Seco", no se han encontrado nunca ejemplares vivos. En el Catálogo Valenciano de Especies de Fauna Amenazadas, y tras los informes relativos al estado de conservación de esta especie realizados por los autores en los últimos años, presentados a la Conselleria de Territori i Habitatge de la Comunidad Valenciana, ha sido incluida con la categoría de "vulnerable" (DOCV nº 4.705, 4/03/2004: p. 4.972). Además, esta especie ha sido propuesta por los autores (en ALONSO, ALTONAGA, ÁLVAREZ, ARAUJO, ARCONADA, ARRÉBOLA, BECH, BROS, CASTILLEJO, GÓMEZ, IBÁÑEZ, LUQUE, MARTÍNEZ-ORTÍ, MORENO, PRIETO, PUENTE, PUJANTE, ROBLES, ROLÁN Y TEMPLADO, 2001) para su protección e inclusión en el Catálogo Nacional de especies Amenazadas, con la categoría de "sensible a la alteración de su hábitat". KERNEY *ET AL.* (1983) señalan que las poblaciones del SE francés se encuentran en proceso de extinción, mientras que KERNEY Y CAMERON (1999) y PAVÓN (2005) opinan que está en regresión. Éste último señala que ha desaparecido del departamento de los Alpes-Maritimes, es muy escasa en el de Var y abundante, aunque amenazado por la urbanización y la degradación del litoral, en el departamento de Bouches-du-Rhône.



Figuras 20-22. Distribución geográfica de los caenogasterópodos terrestres de la Comunidad Valenciana. 20. *Cochlostoma martorelli* (Servain, 1880) (puntos), *Platyla polita polita* (Hartmann, 1840) (cuadros) y *Leonia mamillaris* (Lamarck, 1822) (círculos vacíos). 21. *Pomatias elegans* (O.F. Müller, 1774). 22. *Tudorella sulcata sulcata* (Draparnaud, 1805) (puntos) y *Truncatella subcylindrica* (Linnaeus, 1767) (círculos vacíos).

Figures 20-22. Geographical distribution of the land caenogastropods of the "Comunidad Valenciana" (Spain). 20. Cochlostoma martorelli *(Servain, 1880) (black circles),* Platyla polita polita *(Hartmann, 1840) (squares) and* Leonia mamillaris *(Lamarck, 1822) (white circles). 21.* Pomatias elegans *(O.F. Müller, 1774). 22.* Tudorella sulcata sulcata *(Draparnaud, 1805) (black circles) and* Truncatella subcylindrica *(Linnaeus, 1767) (white circles).*

Familia TRUNCATELLIDAE J.E. Gray, 1840

Truncatella subcylindrica (Linnaeus, 1767) (Figs. 6-10, 22)

Citas previas: ROSELLÓ (1910, 1934): *T. microlena* y *T. truncatula* var. *laevigata*. Valencia (R) (YJ27). GASULL (1971): Calpe. Salinas (BC48); Elche. Salinas de Pinet (YH02).

Observaciones: *T. microlena* Bourguignat, 1884 es una forma de pequeña talla de la variedad lisa de *T. subcylindrica* (GERMAIN, 1931). *T. truncatula* (Draparnaud, 1801) es un sinónimo posterior de *T. subcylindrica* (FRETTER Y GRAHAM, 1978; GERMAIN, 1931; GROSSU, 1986). Se han revisado dos muestras de la colección ROSELLÓ (MCNV) comprobándose que corresponden, efectivamente, a *T. subcylindrica*.

Material inédito: Col. BOSCÁ: Valencia. Puerto. Col. MARTÍNEZ-ORTÍ: Torreblanca, prado pantanoso (BE6252). Col. SIRO DE FEZ: Dénia (BD50) (dos muestras); Valencia (tres muestras).

Discusión: La ornamentación de esta especie es muy variable. En las muestras estudiadas predominan los ejemplares con costulación bien desarrollada (Figs. 6, 9, 10), pero existen algunos en los que este carácter es poco aparente (var. *laevigata* Risso). FRETTER Y GRAHAM (1978: 138) señalan que "entre las costillas son a veces visibles delicadas estrías espirales" mientras que BUTAKOV, CHUHCHIN, CHERKASOVA Y LELEKOV (1997, sin pág.) afirman que la "escultura espiral está ausente". La observación a elevados aumentos de varias conchas, utilizando el M.E.B., muestra la presencia de fila-

mentos espirales muy finos, bien marcados en el espacio comprendido entre las costillas y muy próximos entre sí (Figs. 9, 10).

Distribución geográfica (Fig. 22): Especie con amplia distribución en el Mar Mediterráneo, Mar Negro y Mar de Azov. En el Océano Atlántico se extiende a lo largo de la costa meridional europea hasta el S de Inglaterra y las costas francesas del Canal de la Mancha. Presente también en Azores, Madeira y Canarias (BUTAKOV *ET AL.*1997; FRETTER Y GRAHAM, 1978, 1994; GASULL, 1971; GROSSU, 1986; IBÁÑEZ, ALONSO Y LUIS, 2001; WHITE, 1999). Una antigua introducción en Newport (USA) no ha prosperado (CARLTON, 1992). Su distribución en la Península Ibérica es mal conocida. BECH (1990) recopila las citas de Cataluña. En la Comunidad Valenciana se conoce de las tres provincias. En la de Castellón, donde se cita por primera vez, en la comarca de la Plana Alta, en la de Valencia en la de l'Horta y en la de Alicante en las de la Marina Alta y el Baix Vinalopó en el sur.

Habitat: Vive en la zona supralitoral, enterrada hasta 15 cm entre las raíces de plantas, detritus vegetal y sedimentos finos. Más rara en suelos fangosos, bajo las rocas. Especie anfibia, vive preferentemente al aire libre, pero puede permanecer sumergida durante largos periodos. Es frecuente también en el borde de salinas litorales (GASULL, 1971; GROSSU, 1986; FRETTER Y GRAHAM, 1978, 1994; WHITE, 1999).

CONCLUSIONES

En la Comunidad Valenciana se han identificado seis especies terrestres de caenogasterópodos: *Cochlostoma (Obscurella) martorelli* (Servain, 1880), *Platyla polita polita* (Hartmann, 1840), *Leonia mamillaris* (Lamarck, 1822), *Pomatias elegans* (O.F. Müller, 1774), *Tudorella sulcata sulcata* (Draparnaud, 1805) y *Truncatella subcylindrica* (Linnaeus, 1767).

Desde los puntos de vista biogeográfico y de su interés para la conservación, la importancia de estas especies es muy diferente: *C. (O.) martorelli* posee en esta región el límite meridional de su área de distribución. Esta característica, junto a la escasez de localidades en la misma, recomienda su inclusión en el Catálogo Valenciano de Especies de Fauna Amenazadas (CVEFA). *P. polita polita* está representada en la Península Ibérica solamente por las localidades valencianas, muy alejadas de su área general de distribución. Por ello se ha recomendado su inclusión en dicho Catálogo y probablemente debería incluirse, dada su singularidad, en el Catálogo Nacional. *T. sulcata sulcata* presenta, en el sur de la provincia de Alicante, varias poblaciones relictas sometidas a fuerte presión urbanística. En la Península Ibérica solamente se conocen otras dos poblaciones, una en la provincia de Granada y otra en el Algarve portugués. Las poblaciones del SE francés, donde se describió originalmente, se encuentran en clara regresión. Por todo ello se ha incluido en el CVEFA y se ha recomendado su inclusión en el Catálogo Nacional. *L. mamillaris* y *P. elegans* son especies abundantes en la Comunidad, aunque su distribución geográfica es muy diferente. La primera, iberomagrebí, sólo ocupa el sur de la provincia de Alicante mientras que la segunda, de amplia distribución europea, aparece bien repartida por las tres provincias. Para ambas se amplía su área de distribución hacia el sur peninsular. Ninguna de ellas exige medidas especiales de conservación. Por último, *T. subcylindrica* es una especie de distribución mal conocida en la Península Ibérica, por lo que es difícil evaluar su situación real en la misma.

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Soft-bottom mollusc assemblages in the Ría de Ares-Betanzos (Galicia, NW Spain)

Asociaciones malacológicas de substratos blandos de la Ría de Ares-Betanzos (Galicia, NO España)

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ABSTRACT

The composition and spatial distribution of the mollusc fauna on the subtidal soft bottoms of the Ría de Ares-Betanzos (Galicia, NW Spain) were studied by means of semi-quantitative sampling and multivariate analyses. The faunal distribution in the ría seems to be mainly conditioned by a depth and grain size gradients, the latter defined by a increase in silt/clay and a decrease of coarser granulometric fractions from the mouth towards the margins and inner areas of the ría. Several assemblages were determined which could be defined according to the classic terms of 'community' and 'facies'. Sandy bottoms showed a '*Venus fasciata* community' in coarser sediments of the outer ría, while a '*Venus gallina* community' was found in fine sand at the center of the ría. The shallower and muddier sediments in the inner ría showed a mix of typical species from the '*Abra alba*' and the '*Venus gallina*' communities. However, two facies could be distinguished: the 'facies of *Ringicula auriculata-Pandora inaequivalvis*' in sediments with a greater fine sand content, and the 'facies of *Nassarius pygmaeus-Dentalium novemcostatum*' in the muddiest sediments.

RESUMEN

Se estudia la distribución espacial de los Moluscos en los fondos blandos de la Ría de Ares y Betanzos (Galicia, NO, España) utilizando muestras semi-cuantitativas y técnicas de análisis multivariante. La distribución de la fauna parece estar condicionada principalmente por la profundidad y por los gradientes en el tamaño de grano, definidos por un incremento de la fracción pelítica y una disminución de las fracciones gruesas de sedimento desde la boca hasta los márgenes y zonas internas de la ría. Las agrupaciones halladas pueden ser definidas dentro de los términos clásicos de 'comunidades' y 'facies'. Los fondos de arena en la parte más externa de la ría donde los sedimentos son más gruesos presentan la 'comunidad de *Venus fasciata*', mientras que la 'comunidad de *Venus gallina*' fue encontrada en fondos de arena fina en la parte central de la ría. Los fondos fangosos se encuentran en zonas más someras del interior de la ría y presentan una mezcla de especies típicas de las comunidades de '*Abra alba*' y '*Venus gallina*'. Sin embargo dos facies pueden ser distinguidas: la 'facies de *Ringicula auriculata-Pandora inaequivalvis*' en sedimentos con altos contenidos de arenas finas y la 'facies de *Nassarius pygmaeus-Dentalium novemcostatum*' en los sedimentos más fangosos.

KEY WORDS: Soft-bottom, molluscs, distribution, Ría de Ares-Betanzos.
PALABRAS CLAVE: Substratos blandos, moluscos, distribución, Ría de Ares-Betanzos.

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INTRODUCTION

During the last thirty years, there has been an ongoing interest in the 'rías' of Galicia (NW Spain), which are a special kind of estuarine system. The rías originated from flooded river valleys and have a high primary productivity due to upwellings and regular inflows of nutrients (Nombela, Vilas and Evans, 1995). The great economic and social importance of these systems (fisheries, bivalve culture on rafts, shellfish resources) would greatly benefit from a scientific study of the environment, especially that of the benthic communities, which are good indicators of the conditions of marine bottoms (Bellan, 1967; Pearson and Rosenberg, 1978; Warwick, 1988).

The Ría de Ares-Betanzos is the largest ría of north-west Galicia and is located between the Ría de Coruña and the Ría de Ferrol (Golfo Ártabro). This ría is a double estuarine system with depths ranging between 2 and 43 m (Sánchez-Mata, Glémarec and Mora, 1999). Over the last years, several papers have been devoted to its benthic macrofauna (Sánchez-Mata, Mora, Garmendia and Lastra, 1993; Troncoso and Urgorri, 1993a; Garmendia, Sánchez-Mata and Mora, 1998; Sánchez-Mata and Mora, 1999a; b). Furthermore, the hard-bottom mollusc fauna was studied by Troncoso, Urgorri, Parapar and Lastra (1988) and Troncoso, Urgorri and Olabarría (1996) while Troncoso and Urgorri (1992, 1993b) analyzed the vertical distribution of infauna in the sediment. However, there is a lack of synecological studies on soft-bottom malacofauna. Thus, this paper deals with the distribution of soft-bottom mollusc assemblages and the relation with environmental parameters in the subtidal areas of the Ría de Ares-Betanzos. On the other hand, this area was strongly affected by the Aegean Sea oil spill during 1993, and this paper can therefore serve as a baseline study for future comparisons of molluscan fauna evolution.

MATERIAL AND METHODS

Sample collection: A total of 55 stations were sampled in subtidal soft bottoms to cover adequately the extension of the ría (Fig. 1). Sampling program was carried out between February and November 1986. Semi-quantitative data were obtained using a naturalist rectangular dredge. Sampled area varied between stations depending on nature of substrate; data were standarized to 25 l of collected sediment (maximum volume of dredge net). Samples were sieved through a 0.5 mm mesh; fauna was sorted in the laboratory after fixation in 10% buffered formalin. An additional sediment sample was taken at each station to analyze the granulometric composition, carbonates, nitrogen (N), organic carbon (C) and total organic matter (TOM) contents (Troncoso and Urgorri, 1993a). The following granulometric fractions were considered: gravel (GR, >2 mm), coarse sand (CS, 2-0.5 mm), medium sand (MS, 0.5-0.25 mm), fine sand (FS, 0.25-0.063 mm), and silt/clay (<0.063 mm). Median grain size (Q50), sorting coefficient (So) (Trask, 1932) and C/N ratio were also determined for each sample. Sedimentary types were characterized according to Rodrigues and Quintino (1985) and Junoy and Viéitez (1989).

Data analyses: Total abundance of individuals (N) and number of species (S) were calculated for each sampling station. Mollusc assemblages were determined through non-parametric multivariate techniques as described by Field, Clarke and Warwick (1982) using the PRIMER v5.0 (Plymouth Routines in Multivariate Ecological Research) software package (Clarke and Warwick, 1994). A similarity matrix between sampling stations was constructed by means of the Bray-Curtis similarity coefficient by first applying square root transformation on species abundance to downweight the contribution of the most abundant species. From this matrix, a classification of the stations was performed by cluster analysis based on the group-average sorting algorithm, as well

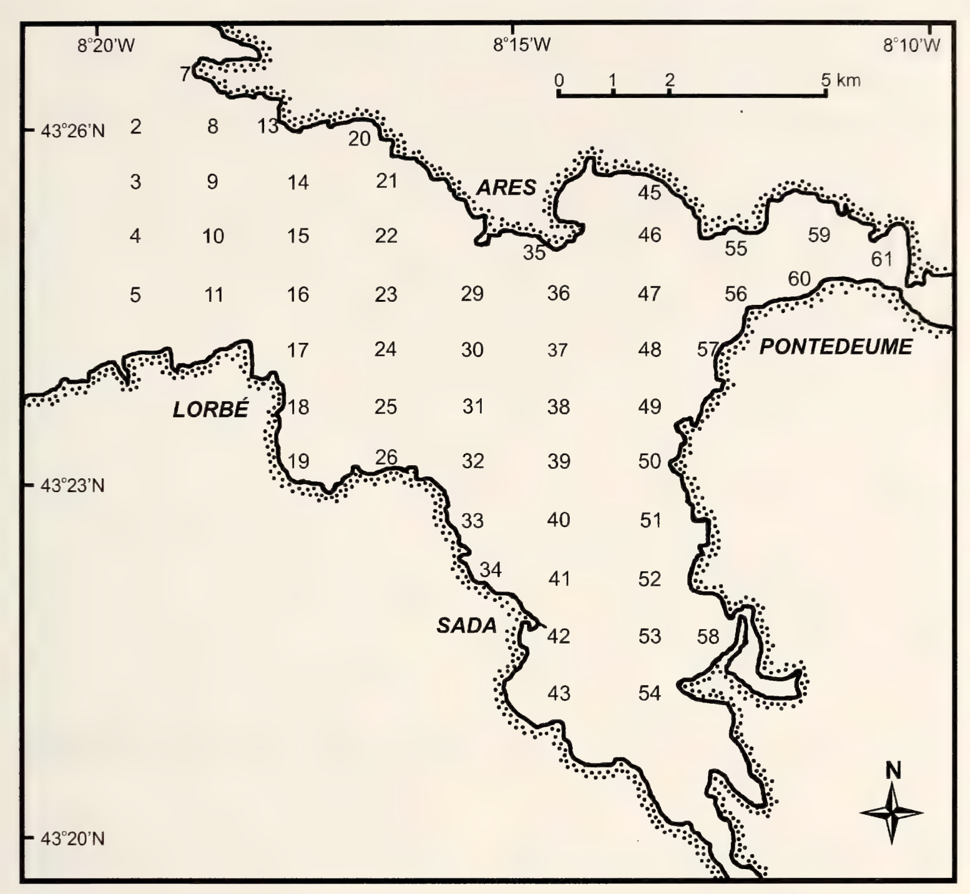


Figure 1. Locations of sampling stations in the Ría de Ares-Betanzos.
Figura 1. Localización de las estaciones de muestreo en la Ría de Ares-Betanzos.

as an ordination by means of non-metrical multidimensional scaling (MDS). Rare species (i.e., those wich appeared in one station and/or with 1–2 invividuals) were included in the final analyses because preliminary trials showed that their supression did not affect classification and ordination of stations. The SIMPER program was next used to identify species that greatly contributed to similarity in a given group derived from those analyses.

The possible relationship between mollusc distribution and the measured environmental variables were researched using the BIO-ENV procedure (belonging to the PRIMER package) and the canonical correspondence analysis (CCA) using the CANOCO v4.02 (Canonical Community Ordination) package (BRAAK, 1988). Forward selection was employed in the latter to detect which variables explained the most variance in the species data. All variables expressed in percentages were previously transformed by log (x+1) and then normalised. Stations 16, 29 and 60 were discarded because of low sediment quantity.

RESULTS

Sediments were mainly of a sandy nature and muddy bottoms were restricted to inner and sheltered areas.

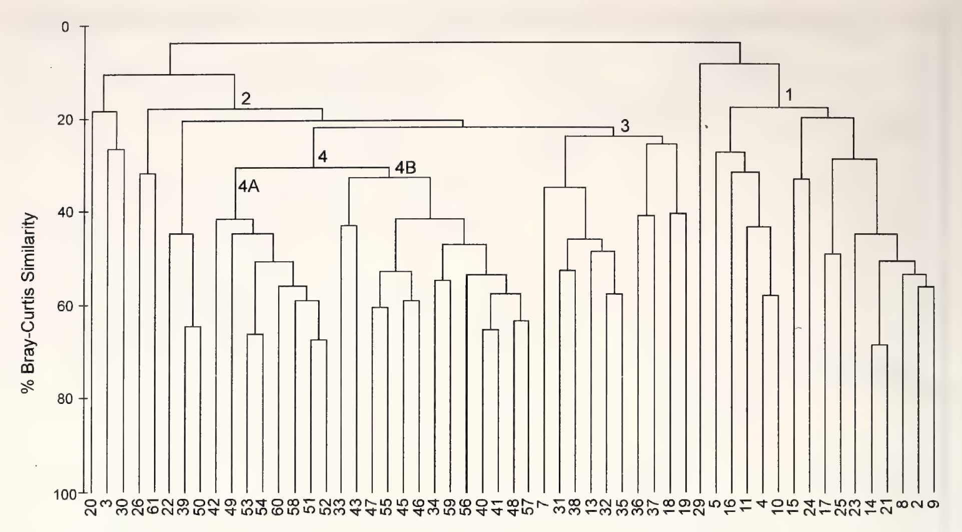


Figure 2. Mollusc assemblages in the Ría de Ares-Betanzos as determined by cluster analysis based on Bray-Curtis similarity coefficient.

Figura 2. Asociaciones malacológicas en la Ría de Ares-Betanzos determinadas por el análisis cluster basado en el coeficiente de similaridad de Bray-Curtis.

Coarser sandy granulometric fractions are greater at the mouth and in the outer areas of the ría and there is a decrease in grain size and an increase in organic content towards the inner areas of the ría (TRONCOSO AND URGORRI, 1993a).

A total of 8030 individuals of molluscs belonging to 116 species were collected, of which 62 were gastropods, 49 bivalves, three polyplacophorans, one scaphopod, and one cephalopod. Gastropods and bivalves were the dominant groups in terms of abundance (48.37 and 46.54%, respectively), followed by scaphopods (4.65%). A complete list of the collected species is provided by TRONCOSO, URGORRI AND PARAPAR (1993). The gastropods *Nassarius reticulatus* (Linné, 1758), *N. pygmaeus* (Lamarck, 1822) and *Ringicula auriculata* (Ménard, 1811), the bivalves *Chamelea striatula* (da Costa, 1778), *Pandora inaequivalvis* (Linné, 1758) and *Goodallia triangularis* (Montagu, 1803), and the scaphopod *Dentalium novemcostatum* Lamarck, 1818 were the most abundant species in the ría, accounting for 50% of the total mollusc abundance. These species reached their highest abundances in finer sediments excepting *G. triangularis* which prefers coarser sandy sediments (coarse and medium sand).

Multivariate analysis: Cluster analysis and MDS ordination revealed the presence of two large groups of stations at a 12% similarity level (Figs. 2, 3): group 1, comprised sampling stations with coarse sediments (St. 2, 4, 5, 8, 9, 10, 11, 14, 15, 16, 17, 21, 23, 24, 25), and group 2, comprised bottoms of finer granulometry (St. 7, 13, 18, 19, 22, 26, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61). Group 2 could be split into two further groups (25% similarity level): group 3, fine sand bottoms (St. 7, 13, 18, 19, 31, 32, 35, 36, 37, 38), and group 4, sandy bottoms with higher content in silt/clay (St. 33, 34, 40, 41, 42, 43, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60). Furthermore, group 4 could be split in two subgroups (32% similarity level): 4A, which had a greater content of fine sand (St. 42, 49, 51, 52, 53, 54, 58, 60), and 4B, which was comprised of muddier sediments (St. 33, 34, 40, 41, 43, 45, 46, 47, 48, 55, 56, 57, 59). MDS ordination, however, suggests that St. 43 has a greater affinity

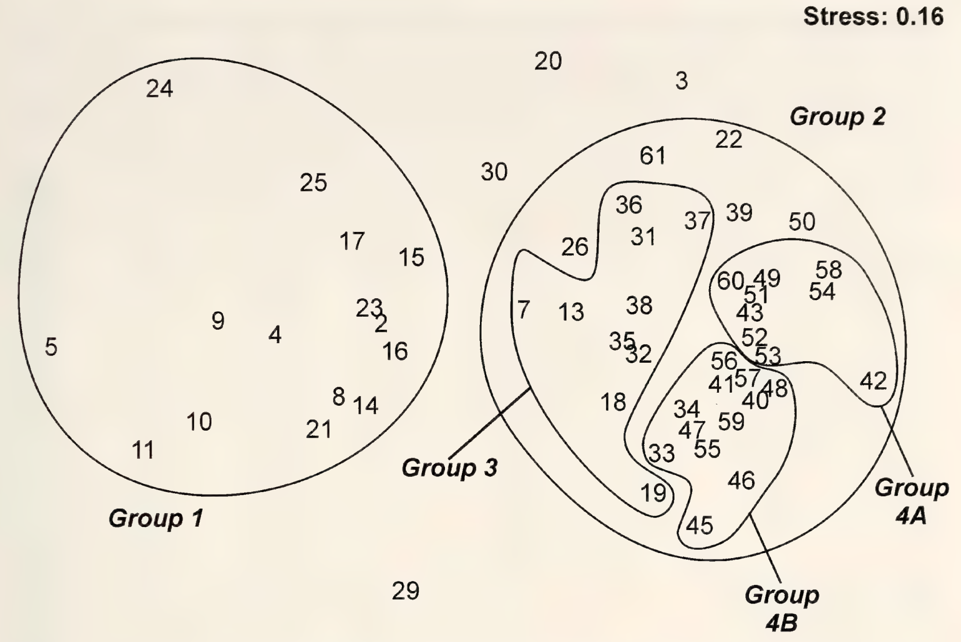


Figure 3. Non-metric multidimensional scaling (MDS) ordination of mollusc assemblages in the Ría de Ares-Betanzos. Groups derived from cluster analysis are delimited by lines.
Figura 3. Ordenación MDS de las asociaciones malacológicas en la Ría de Ares-Betanzos. Los grupos derivados del análisis cluster estan delimitados por líneas.

for subgroup 4A in opposition to that showed in the dendrogram.

MDS ordination also revealed that several sampling points were displaced from the main groupings: St. 3 was a muddy sand basin located in the middle of coarse sands and shows a high abundance of *Acanthocardia paucicostata* (Sowerby, 1841); the samples from St. 20 and St. 30 were very poor in terms of malacofauna; St. 29 had species which are typical of rocky bottoms. On the other hand, St. 22, 39 and 50 appeared displaced from the two main groups within group 2. In addition, St. 26 and 61 show affinities with group 3 but the former is characterized by a dominance of the bivalve *Glycimeris glycimeris* (Linné, 1758) and the latter for the presence of the bivalve *Donax trunculus* Linné, 1758.

Results of the SIMPER analysis are shown in Table I. The bivalves *Goodallia triangularis*, *Clausinella fasciata* (da Costa, 1778) and *Gari tellinella* (Lamarck, 1818) are the species with a greater contribution to similarity (up to a cumulative 70%) for coarser sandy bottoms of group 1. Group 3 is mainly determined by *Chamelea striatula* and *Nassarius reticulatus*. Group 4A is defined by *Ringicula auriculata*, *Pandora inaequivalvis*, *N. reticulatus* and *C. striatula*. Group 4B is characterized by *Nassarius pygmaeus*, *N. reticulatus*, *Nucula nitidosa* Winckworth, 1930, *C. striatula*, *Dentalium novemcostatum*, *R. auriculata*, *Corbula gibba* (Olivi, 1792), *P. inaequivalvis* and *Montacuta phascolionis* Dautzenberg and Fisher, 1925.

The BIO-ENV procedure (Table II) showed that the best combinations of environmental variables via the highest correlations with faunistic data was that composed of depth, gravel, fine sand and silt/clay. Depth was the variable with the best value when each variable was considered alone (ρw: 0.464). The

Table I. Results of SIMPER analysis. Species were ranked according to their average contribution to similarity between assemblages in the Ría de Ares-Betanzos. Average abundance, ratio value (similarity/standard deviation, Sim./SD), and percentage of cumulative similarity were also included.
Tabla I. Resultados del análisis Simper. Los rangos de las especies están organizados de acuerdo con la contribución a la similaridad entre los grupos de estaciones en la Ría de Ares-Betanzos. Se incluye la abundancia media, valor del 'ratio' (similaridad/desviación estándar, Sim./SD), y el porcentaje de la similaridad acumulada.

Group 1 (average simil.: 26.01%)	Av.Abund.	Av.Sim.	Sim./SD	Contrib.%	Cum.%
Goodallia triangularis (Montagu, 1803)	28.53	7.78	0.88	29.92	29.92
Clausinella fasciata (da Costa, 1778)	13.87	7.40	1.00	28.44	58.36
Gari tellinella (Lamarck, 1818)	3.87	2.91	0.71	11.19	69.55
Spisula elliptica (Brown, 1827)	0.73	0.95	0.35	3.65	73.20
Timoclea ovata (Pennant, 1777)	6.33	0.80	0.28	3.06	76.26
Tellina donacina Linné, 1758	2.13	0.77	0.29	2.98	79.24
Retusa mammillata (Philippi, 1836)	1.07	0.74	0.28	2.84	82.07
Caecum trachea (Kanmacher, 1798)	12.73	0.60	0.27	2.32	84.40
Caecum glabrum (Montagu, 1803)	4.00	0.56	0.27	2.14	86.54
Euspira pulchella (Risso, 1826)	0.40	0.51	0.29	1.96	88.50
Obtusella intersecta (Wood, 1857)	1.73	0.48	0.22	1.86	90.36
Group 3 (average simil.: 28.74%)	Av.Abund.	Av.Sim.	Sim./SD	Contrib.%	Cum.%
Chamelea striatula (da Costa, 1778)	21.33	13.01	1.34	45.27	45.27
Nassarius reticulatus (Linné, 1758)	15.50	8.13	2.04	28.30	73.56
Thracia papyracea (Poli, 1791)	7.50	1.65	0.37	5.74	79.30
Tellina fabula Gmelin, 1791	3.50	1.44	0.46	5.01	84.31
Mysella bidentata (Montagu, 1803)	3.17	1.37	0.53	4.78	89.09
Turbonilla acuta (Donovan, 1804)	9.50	0.94	0.32	3.26	92.35
Group 4A (average simil.: 43.38%)	Av.Abund.	Av.Sim.	Sim./SD	Contrib.%	Cum.%
Ringicula auriculata (Ménard, 1811)	49.10	12.76	1.59	29.42	29.42
Pandora inaequivalvis (Linné, 1758)	32.80	11.56	2.22	26.65	56.07
Nassarius reticulatus (Linné, 1758)	5.00	3.46	1.01	7.98	64.04
Chamelea striatula (da Costa, 1778)	12.80	3.37	0.66	7.78	71.82
Mactra stultorum (Linné, 1758)	2.40	2.61	1.18	6.01	77.84
Turbonilla acuta (Donovan, 1804)	3.70	2.03	0.75	4.68	82.51
Spisula subtruncata (da Costa, 1778)	3.80	1.96	0.69	4.51	87.02
Nassarius pygmaeus (Lamarck, 1822)	11.40	1.37	0.37	3.15	90.17
Group 4B (average simil.: 44.86%)	Av.Abund.	Av.Sim.	Sim./SD	Contrib.%	Cum.%
Nassarius pygmaeus (Lamarck, 1822)	34.58	5.98	1.27	13.33	13.33
Nassarius reticulatus (Linné, 1758)	26.58	5.18	2.43	11.55	24.88
Nucula nitidosa Winckworth, 1930	16.25	4.61	2.81	10.28	35.16
Chamelea striatula (da Costa, 1778)	15.83	3.94	1.33	8.77	43.94
Dentalium novemcostatum Lamarck, 1818	30.92	3.07	0.94	6.85	50.79
Ringicula auriculata (Ménard, 1811)	9.83	2.82	1.58	6.30	57.08
Corbula gibba (Olivi, 1792)	18.75	2.73	1.14	6.09	63.17
Pandora inaequivalvis (Linné, 1758)	8.42	2.21	0.89	4.92	68.09
Montacuta phascolionis Dautzenberg & Fisher, 1925	9.83	1.65	0.88	3.68	71.77
Odostomia unidentata (Montagu, 1803)	14.50	1.54	1.05	3.42	75.20
Chrysallida indistincta (Montagu, 1808)	10.58	1.46	0.92	3.26	78.46
Philine aperta (Linné, 1767)	6.42	1.32	0.70	2.94	81.40
Volvulella acuminata (Bruguiére, 1792)	3.33	1.28	1.25	2.85	84.25
Acanthocardia paucicostata (Sowerby, 1841)	10.58	1.22	0.94	2.72	86.97
Thyasira flexuosa (Montagu, 1803)	4.92	0.66	0.60	1.47	88.44
Ondina diaphana (Jeffreys, 1848)	3.58	0.62	0.63	1.39	89.83
Abra alba (Wood, 1802)	3.67	0.60	0.58	1.34	91.17

Table II. Best combinations of variables obtained through BIO-ENV analysis according the values of the Spearman's rank correlation (*p*w) for the Ría de Ares-Betanzos. GR, gravel; CS, coarse sand; FS, fine sand; Q50, median grain size; C/N, Carbon-Nitrogen ratio.
Tabla II. Mejores combinaciones de variables obtenidas a través del análisis BIO-ENV de acuerdo con los valores del coeficiente de correlación de rango de Spearman (pw) para la Ría de Ares-Betanzos. GR, grava; CS, arena gruesa; FS, arena fina; Q50, mediana del tamaño de grano; C/N, relación Carbono-Nitrógeno.

Number of variables	Correlation (pw)	Best variable combination
2	0.508	Depth-FS
3	0.511	Depth-GR-FS
4	0.518	Depth-GR-FS-Silt/Clay
	0.515	Depth-Q_{50}-GR-FS
5	0.516	Depth-Q_{50}-GR-FS-Silt/Clay
	0.516	Depth-GR-CS-FS-Silt/Clay
	0.514	Depth-C/N-CS-FS-Silt/Clay
6	0.516	Depth-Q_{50}-GR-CS-FS-Silt/Clay
	0.515	Depth-C/N-GR-CS-FS-Silt/Clay
	0.512	Depth-Q_{50}-C/N-GR-FS-Silt/Clay
	All 13 variables: 0.410	

Table III. Summary of canonical correspondence analysis (CCA) for the Ría de Ares-Betanzos.
Tabla III. Resumen del análisis de correspondencias canónicas (CCA) para la Ría de Ares-Betanzos.

Axes	I	II	III	IV	Total inertia
Eigenvalues	0.701	0.274	0.212	0.167	5.784
Species-environment correlations	0.927	0.869	0.824	0.883	
Cumulative percentage variance					
of species data	12.1	16.8	20.5	23.4	
of species-environment relation	34.4	47.9	58.3	66.5	
Sum of all unconstrained eigenvalues					5.784
Sum of all canonical eigenvalues					2.035

forward selection of CCA selected depth and gravel as the variables explaining most of the variance in the species data ($p<0.01$), while fine sand and median grain size were found significant only at the 5% level. Axes I and II accumulate 16.8% of the species variance and 47.9% of species-environment variance (Table III). Depth, median grain size, fine sand and silt/clay showed the highest correlations with axis I; correlations with the other axes were less significant. Sampling stations appeared distributed from the right to the left of axis I following an increase in content of fine sand and silt/clay and a decrease in depth and median grain size (Fig. 4). The same pattern can be observed in the MDS ordination with superimposed values of depth, gravel, fine sand and silt/clay (Fig. 5). Thus, the different analyses suggested that distribution of fauna in the study area is mainly related to a depth and grain size gradient.

Description of assemblages: Distribution in the Ría de Ares-Betanzos of the mollusc assemblages determined by multivariate analyses are shown in

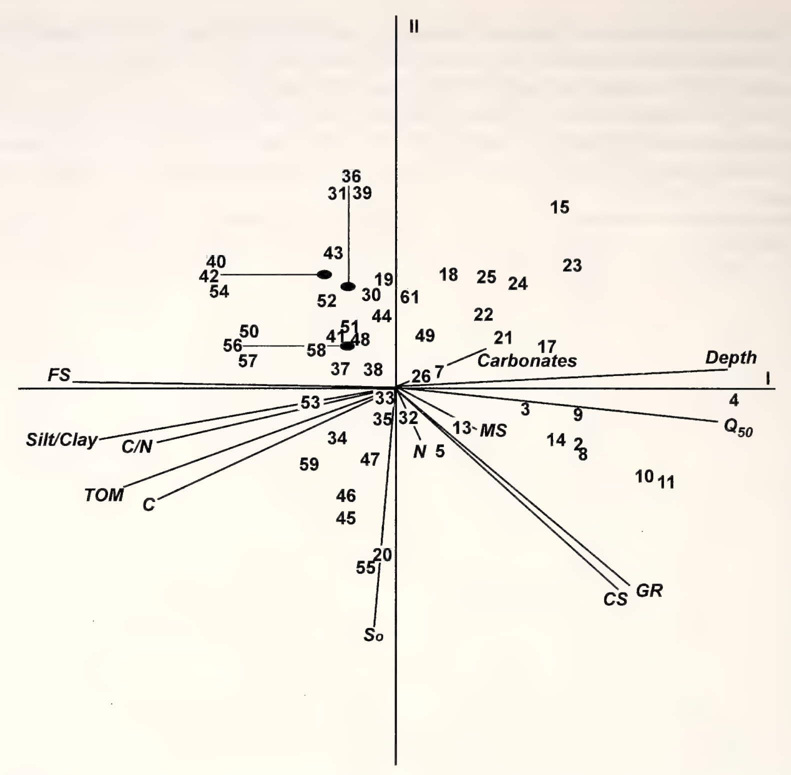


Figure 4. Canonical correspondence analysis (CCA) ordination of stations and environmental variables relative to axes I and II for the Ría de Ares-Betanzos. GR, gravel; CS, coarse sand; MS, medium sand; FS, fine sand; Q50, median grain size; So, sorting coefficient; TOM, total organic matter; C, organic carbon; N, nitrogen; C/N, Carbon-Nitrogen ratio.

Figura 4. Ordenación de las estaciones de muestreo y variables ambientales de la Ría de Ares-Betanzos para los ejes I y II del análisis de correspondencias canónicas (CCA). GR, grava; CS, arena gruesa; MS, arena media; FS, arena fina; Q50, mediana del tamaño de grano; So, coeficiente de selección; TOM, materia orgánica total; C, carbono orgánico; N, nitrógeno; C/N, relación Carbono-Nitrógeno.

Figure 6 and their environmental and faunistic characteristics in Table IV.

Group 1 is comprised of the deepest bottoms of the ría; sediments are mostly composed of coarse sand, medium sand and gravel with a high carbonate content. The assemblage is numerically dominated by *Goodallia triangularis*, *Caecum trachea* (Kanmacher, 1798) and *Clausinella fasciata*; other characteristic species were *Gari tellinella*, *Timoclea ovata* (Pennant, 1777) and *Caecum glabrum* (Montagu, 1803), which are distributed almost exclusively in these bottoms.

In Group 3, sediment are composed of fine sand and median sand and has a higher amount of silt/clay and carbonate content than group 1. The species composition of these bottoms indicates a transition between the fauna of coarser sediments (group 1) and muddy sand/muds (groups 4A, 4B). This assemblage is characterized by a high abundance of *Chamelea striatula*, *Nassarius reticulatus* and *Turbonilla acuta* (Donovan, 1804) and by the presence of *Thracia papyracea* and *Mysella bidentata*. Mollusc abundance per station is lower than in coarse sands and total species number is greater (49 vs 38). The MDS ordination showed that stations 22 and 61 have certain affinities with this

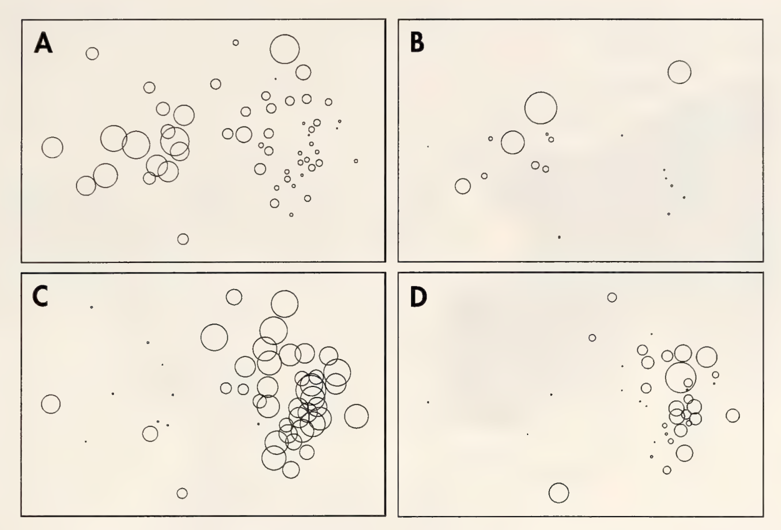


Figure 5. Non-metric multidimensional scaling (MDS) ordination of mollusc assemblages in the Ría de Ares-Betanzos with superimposed values of the abiotic variables selected by BIO-ENV analysis. A: depth; B: gravel; C: fine sand; D: silt/clay. Circle size is proportional to values of variables in each sampling station.

Figura 5. Ordenación MDS de las asociaciones malacológicas en la Ría de Ares-Betanzos con los valores superpuestos de las variables abióticas seleccionadas por el análisis BIO-ENV. A: profundidad; B: grava; C: arena fina; D: limos/arcillas. El tamaño de los círculos es proporcional al valor de las variables en cada estación de muestreo.

assemblage, although the presence of *Tellina fabula* Gmelin, 1791 and *Donax trunculus* also suggest a mix with the faunal assemblage from intertidal sediments.

Group 4A is spread in shallower bottoms which have a greater fine sand and silt/clay content. Total abundance and species number per station are higher than in the previous groups. The dominant species are *Ringicula auriculata* and *Pandora inaequivalvis*, and several species, such as *Chamelea striatula* and *Nassarius reticulatus,* were shared with group 3 although in lower abundances and with a more irregular presence. On the other hand, the bivalves *Mactra stultorum* and *Spisula subtruncata* were mostly found in this assemblage.

Sediments in group 4B are slightly muddier than those of group 4A and have a greater organic content. Dominant species in terms of abundance were *Nassarius pygmaeus, Dentalium novemcostatum* and *Nucula nitidosa;* other characteristics species were *Corbula gibba, Nassarius reticulatus, Acanthocardia paucicostata, Chamelea striatula, Ringicula auriculata* and *Pandora inaequivalvis,* although the latter two were less abundant than in group 4A.

DISCUSSION

According to our analyses, the distribution of the molluscan fauna in the Ría de Ares-Betanzos seems to be primarily determined by gradients in depth and grain size. The latter was characterized by an increase in fine sand and silt/clay content from the mouth of the ría towards the inner margins. This sedimentary gradient is related to tidal current systems and interactions between oceanic and continental water (SÁNCHEZ-MATA *ET AL.*, 1999). The presence of coarser sediments in the mouth is due to a stronger hidrodynamism (TRONCOSO *ET AL.*, 1993) while a deposi-

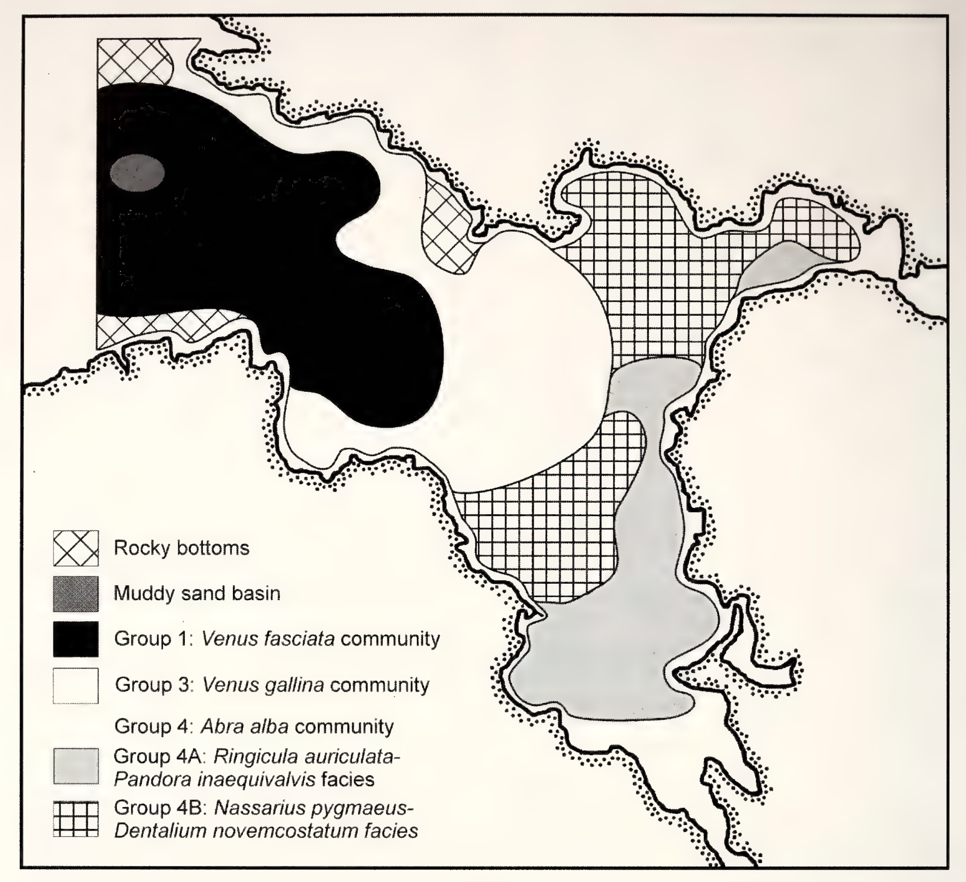


Figure 6. Spatial distribution of mollusc assemblages in the Ría de Ares-Betanzos as determined through cluster analysis.

Figura 6. Distribución espacial de las asociaciones malacológicas en la Ría de Ares-Betanzos determinadas por el análisis cluster.

tion of finer fractions occurs in inner, sheltered areas. This relationship of depth and sedimentary composition with faunal distribution was also observed by a large number of authors (RHOADS AND YOUNG, 1970; GRAY, 1974; EVANS AND TALLMARK, 1976; GLÉMAREC, 1978; TUNBERG, 1981).

According to their faunistic composition and environmental features, the mollusc assemblages in the Ría de Ares-Betanzos could be defined using the classic terms of 'community' and 'facies' (PETERSEN, 1918; THORSON, 1957). Thus, group 1 has a fauna that could be included among the different varieties of the '*Branchiostoma lanceolatum-Venus fasciata* community' (THORSON, 1957). Several authors have reported the presence of similar faunal associations in other areas of Galicia such as Ría da Coruña (LÓPEZ-JAMAR AND MEJUTO, 1985) and Ensenada de Baiona (MOREIRA, QUINTAS AND TRONCOSO, 2005). These bottoms have clean coarse sediments with a high content of biogenic carbonates and are located at the outer areas of the rías where the hydrodynamism is stronger (NOMBELA, VILAS, RODRÍGUEZ AND ARES, 1987). The fauna present in group 3 agrees with the description of the '*Venus gallina* commu-

Table IV. Summary of biotic and physical characteristics of the four molluscan assemblages in the Ría de Ares-Betanzos determined through cluster analyses (values: mean ± standard deviation). Dominant species in any given assemblage are those which account for ≥75% of total abundance.
Tabla IV. Resumen de las características bióticas y físicas de las cuatro asociaciones malacológicas de la Ría de Ares-Betanzos determinadas a traves del análisis cluster (valores: media ± desviación estándar). Las especies consideradas como dominantes en cada una de las asociaciones fueron áquellas que representaron ≥75% de la abundancia total.

	Group 1	Group 3	Group 4A	Group 4B
Dominant species	*Goodallia triangularis* *Clausinella fasciata* *Caecum trachea* *Timoclea ovata*	*Chamelea striatula* *Nassarius reticulatus* *Turbonilla acuta* *Thracia papyracea* *Chrysallida decussata*	*Ringicula auriculata* *Pandora inaequivalvis* *Chamelea striatula* *Nassarius pygmaeus*	*Nassarius pygmaeus* *Dentalium novencostatum* *Nassarius reticulatus* *Corbula gibba* *Nucula nitidosa* *Chamelea striatula* *Odostomia unidentata* *Calyptraea chinensis* *Acanthocardia paucicostata* *Chrysallida indistincta* *Ringicula auriculata* *Montacuta phascolionis*
N	89.93±87.65	79.67±53.61	172.22±114.38	286.50±179.15
S	8.86±5.08	8.67±3.70	12.44±3.68	22.92±6.89
Depth	27.35±8.33	13.21±2.58	5.78±3.10	7.21±2.30
% Gravel	18.29±23.63	1.25±2.56	0.07±0.10	1.85±2.14
% Coarse sand	52.04±25.62	9.12±16.16	2.29±2.59	7.33±8.17
% Medium sand	18.76±19.65	20.39±16.16	9.84±14.77	10.09±8.17
% Fine sand	10.51±18.33	60.53±17.82	73.20±15.70	64.78±11.68
% Silt/Clay	0.39±0.60	8.71±7.91	14.60±11.11	15.96±8.76
Q_{50} (mm)	0.87±0.59	0.17±0.07	0.13±0.05	0.14±0.05
Sedimentary type	Coarse/medium sand	Fine/muddy sand	Fine/muddy sand	Muddy sand/Sandy mud
% TOM	0.14±0.19	0.44±0.18	0.86±0.48	1.13±0.77
% Carbonates	38.47±21.92	40.49±8.66	29.50±6.48	28.15±13.7

nity' (THORSON, 1957), corresponding to the fine sand bottoms of the center and northern outer margin of the ría in which the bivalve *Chamelea striatula* and the gastropod *Nassarius reticulatus* show their greater abundance. Both species are also spread in shallower finer sandy bottoms although in lower abundances.

Even though group 4 have some species typical of the '*Venus gallina* community' such as *Chamelea striatula* and *Mactra stultorum*, there is an important presence of several other species which show preference for muddier sediments (*Corbula gibba, Thyasira flexuosa, Nucula nitidosa*). Thus, this group could be considered as a mix between the already mentioned community and the '*Syndosmia* (=*Abra*) *alba* community' of PETERSEN (1918). This situation agrees with the results showed by Sánchez-MATA AND MORA (1999b) for all groups of macrofauna in the Ares sector of the ría. On the other hand, the '*Abra alba* community' has been reported along European coasts in different types of muddy bottoms (REES AND WALKER, 1983; GENTIL, IRLINGER, ELKAIM AND PRONIEWSKI, 1986; LASTRA, MORA, SÁNCHEZ AND TRONCOSO, 1988) as well as in Galician

rías (Cadée, 1968; Olabarría, Urgorri and Troncoso, 1998; Sánchez-Mata and Mora, 1999b; Moreira *et al.*, 2005). However, multivariate analyses have distinguished two further groups within group 4, which can be characterized as two different malacological 'facies'. The facies corresponding to group 4A is determined by the dominance of *Ringicula auriculata* and *Pandora inaequivalvis*, and that present in group 4B is characterized by *Nassarius pygmaeus* and *Dentalium novemcostatum* and shows a greater presence of species preferring muddier sediments. Several authors have suggested that the different proportion of sand and silt/clay is a major factor in structuring benthic communities (Rhoads and Young, 1970; Gray, 1974). Webb (1969) pointed out that even a small silt/clay content affects the sediment porosity and therefore the faunal composition. In the Ría de Ares-Betanzos, the variations in amount of fine sand and silt/clay seems to condition mollusc species abundance across these bottoms and consequently the presence of any given facies.

In general, mollusc distribution in sandy sediments of the outer and central part of the ría is similar to those observed in Ría de Coruña (López-Jamar and Mejuto, 1985) and Ensenada de Baiona (Moreira *et al.*, 2005). The transition between the '*Venus gallina*' and the '*Abra alba*' communities occurring in the inner areas of the Ría de Ares-Betanzos has been also reported for several Galician Rías (López-Jamar, 1981; Sánchez-Mata and Mora, 1999b). Although multivariate analyses were able to distinguish the two described facies in finer sediments in the Ría de Ares-Betanzos, there are several abundant species which are widespread, such as *Chamelea striatula, Nassarius reticulatus, Pandora inaequivalvis* and *Ringicula auriculata*. This situation agrees with the '*continuum*' concept which implies that species are independently distributed along environmental gradients (Curtis, 1955). Thus, co-existence or overlap between them in any given assemblage would be related to their reactions to the existing gradients (Mackie, Oliver and Rees, 1995). In our case, variations in abundance of any given mollusc species across the different assemblages in Ría de Ares-Betanzos would be conditioned by a depth-grain size gradient.

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Estado de la especie amenazada *Patella ferruginea* Gmelin, 1791 (Gastropoda: Patellidae) en la bahía de Algeciras y Gibraltar

Status of the endangered limpet *Patella ferruginea* Gmelin, 1791 (Gastropoda: Patellidae) in the Algeciras bay and Gibraltar

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RESUMEN

El molusco marino *Patella ferruginea* está considerado como una de las especies en mayor peligro de extinción del Mediterráneo. En 2004 se ha llevado a cabo un estudio para establecer la distribución, abundancia y talla de la especie en la bahía de Algeciras. Un total de 140 individuos fueron censados sobre una línea de costa de unos 20 km, presentando los mayores valores a lo largo de la costa este de la bahía. Esto representa la mayor población conocida de esta especie en las costas de la península Ibérica. Aunque se encontraron un mayor número de ejemplares en construcciones artificiales, como diques, las mayores densidades aparecieron en sustratos naturales. Las diferencias entre ambos tipos de sustratos no fueron significativas, aunque esto pueda deberse al bajo número de ejemplares encontrados en comparación con otras áreas mediterráneas del norte de África. La distribución normal de tallas encontrada indica que el área muestreada podría albergar una población bien establecida y reproductora. Se requieren urgentemente nuevos estudios para establecer programas de gestión y conservación para esta especie, dado su elevado riesgo de extinción.

ABSTRACT

The marine mollusc *Patella ferruginea* is considered one of the species in greatest danger of extinction in the Mediterranean. A study was carried out to establish the distribution extent, abundance and size of this species in the Bay of Algeciras (Strait of Gibraltar) in 2004. A total of 140 individuals were found over approximately 20km of coastline, with the highest numbers occurring along the eastern shores of the Bay. This represents the largest known population of this limpet species along the coast of Iberia. Although higher overall numbers were encountered along artifical constructions such as breakwaters, highest densities occurred on natural rocky substrates. Differences between both types of substrates were not significant, probably due to the relatively low overall numbers encountered. A normal distribution of body sizes was found in this study, indicating that the area sampled could contain a well-established breeding population. New studies are urgently required to establish and implement management programmes and conservation plans for this species due its high risk of extinction.

PALABRAS CLAVE: *Patella ferruginea*, conservación, bahía de Algeciras, Gibraltar, lapas.
KEYWORDS: *Patella ferruginea*, conservation, Algeciras bay, Gibraltar, limpets.

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INTRODUCCIÓN

El molusco marino *Patella ferruginea* Gmelin, 1791, es una especie que se encuentra protegida tanto por las leyes de la Unión Europea (Directiva 92/43/CEE de 21 de mayo de 1992 en el Anexo IV "especies animales y vegetales de interés comunitario que requieren una protección estricta"), así como por la legislación española (Orden de 9 de junio de 1999. Especie considerada en "peligro de extinción") y gibraltareña (Government of Gibraltar, Nature Protection Ordinance 1991). Está considerada como una de las especies marinas mediterráneas más amenazadas de extinción (LABOREL-DEGUEN Y LABOREL, 1991a) y su área de distribución se ha visto reducida a unas pocas localidades en el Mediterráneo occidental en los últimos tiempos (FISCHER-PIETTE, 1959; LABOREL-DEGUEN Y LABOREL, 1991a; CRETELLA, SCILLITANI, TOSCANO, TURELLA, PICARIELLO Y CATAUDO, 1994; TEMPLADO, CALVO, GARVÍA, LUQUE, MALDONADO Y MOZO, 2004).

En la península Ibérica las citas recientes (a partir de los años 80 del siglo XX) son escasas. La primera cita escrita reciente de la especie en las costas peninsulares españolas ha sido aportada por GRANDFILS (1982) y GRANDFILS Y VEGA (1982) que mencionan 17 ejemplares en la costa de Málaga. Después, GARCÍA-GÓMEZ (1983) la cita como rara en la bahía de Algeciras, mientras que MORENO (1992) encontró dos ejemplares en Cabo de Gata (Almería). También FA (1990), encontró un solo individuo en el puerto de Gibraltar durante 1989. Más recientemente, varios ejemplares fueron detectados en el puerto de Gibraltar por Templado en 1995 (comunicación personal en RAMOS, 1998) y TEMPLADO, FA Y OCAÑA en 2002 (comunicación personal), así como un ejemplar aislado en Punta Carnero (FA, 1998). Según TEMPLADO Y MORENO (1997), la especie se encuentra prácticamente extinguida de las costas continentales europeas, situándola al borde de la desaparición en las costas del sur de la península, dónde persistiría en puntos aislados. Es de gran interés describir y cuantificar la estructura de las poblaciones de *Patella ferruginea* allí dónde aún persisten (PARACUELLOS, NEVADO, MORENO, GIMÉNEZ Y ALESINA, 2003). Por ello, el presente estudio tiene como objetivo cuantificar y describir la población presente en la bahía de Algeciras, representando el primer estudio poblacional sobre *Patella ferruginea* llevado a cabo en las costas de la península Ibérica. El conocimiento de las poblaciones aún existentes es fundamental para implementar medidas de conservación encaminadas a evitar la crítica situación de la especie, situación que roza la extinción total, si nos referimos a las costas peninsulares.

MATERIAL Y MÉTODOS

En base a las informaciones previas, la bahía de Algeciras podía albergar alguna población de *Patella ferruginea*, por ello se centró el estudio en todo el arco de todo este golfo natural, desde punta Carnero (36° 04,600′ N - 5° 25,460′ O) como límite occidental, hasta la zona este del peñón de Gibraltar (36° 07,698′ N - 5° 20,477′ O) como límite oriental. Se visitaron en marzo de 2004 todas las localidades susceptibles de albergar poblaciones de esta lapa, éstos fueron tanto en sustratos rocosos naturales como diques artificiales que se encontraban presentes en el área de estudio. Las zonas de playa fueron excluídas del muestreo. En cada localidad se realizó el censo de todos los ejemplares observados durante la bajamar, anotando la talla del eje anteroposterior de la concha con un calibre y registrando la posición de cada localidad mediante un GPS Garmin 45XL. Para el cálculo de la densidad se estimó la distancia muestreada en cada localidad utilizando la carta naútica 445A del Instituto Hidrográfico de la Marina. En la Figura 1 se pueden apreciar las localidades de muestreo, mientras que en la Tabla I se detallan las coordenadas geográficas de cada una. Adicionalmente, durante el presente

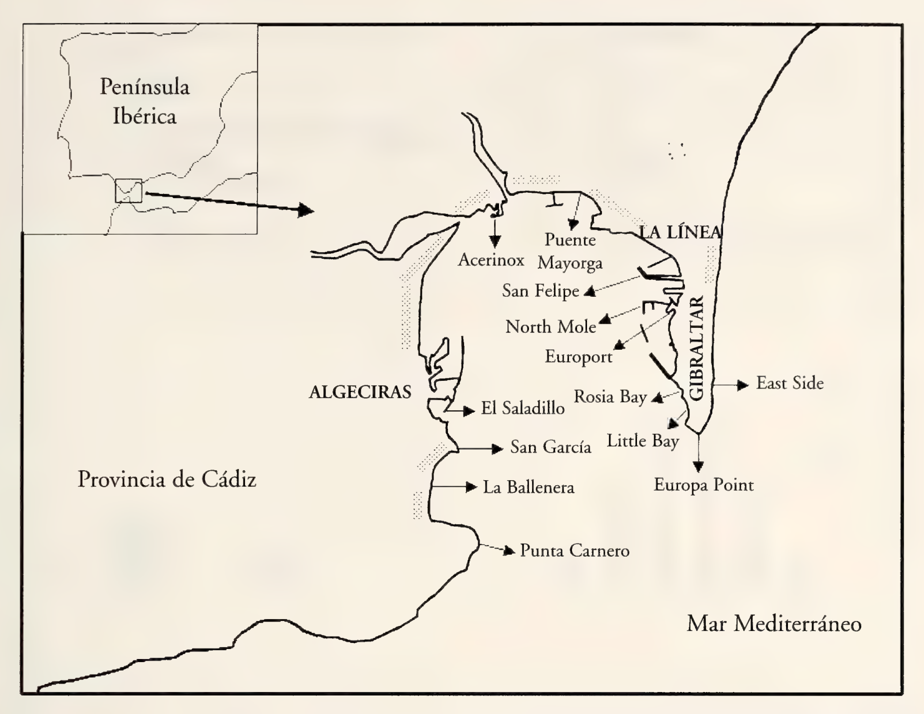


Figura 1. Mapa de la bahía de Algeciras y Gibraltar donde se indican las localidades de muestreo. En trama punteada se denotan las zonas de playa.
Figure 1. Map of Algeciras Bay and Gibraltar, showing the sampling localities. Shaded areas indicate beach zones.

estudio se prospectaron algunas otras localidades en el sur peninsular.

Los datos obtenidos fueron sometidos a un test no paramétrico Kruskal-Wallis de comparación de medias, ya que no se verificó normalidad de los datos con el test de Shapiro-Wilk. Estos tratamientos estadísticos fueron realizados con el Biomedical Statistical Package (BMDP) (DIXON, 1983).

RESULTADOS

El número total de ejemplares detectados en el presente estudio fue de 140. Este contingente aparecía, sin embargo, distribuído de forma muy irregular (Fig. 2). La zona este de la bahía de Algeciras (Gibraltar y La Línea: desde East Side hasta San Felipe) albergaban la mayor cantidad de ejemplares (114), mientras que en la zona oeste (desde Puente Mayorga a San García), sólo se encontraron 26 ejemplares. En las restantes localidades muestreadas no apareció ningún ejemplar. Atendiendo a la densidad obtenida, los resultados son similares, presentando los mayores valores la zona externa a la bahía hacia el Mediterráneo (Fig. 3).

Al comparar la densidad en sustrato natural frente a la encontrada en sustrato artificial, se observa como la media en sustrato natural fue de 0,14 ind./m (±0,20), mientras que en el caso del sustrato artificial fue de 0,08 ind./m (±0,04), prácticamente el doble. No obstante no se apreciaron diferencias estadísticamente significativas mediante el test no paramétrico de Kruskal-Wallis entre ambas situaciones (K=0,06; p=0,80), debido a la elevada desviación estándar obtenida, ya que existía una gran variabilidad entre localidades (Fig. 4).

La estructura de tallas de la población se ajustaba a una distribución

Tabla I. Coordenadas geográficas de cada una de las localidades muestreadas. Los asteriscos indican sustrato natural.
Table I. Geographic coordinates of each sampled locality. Asteriscs indicate natural substrates.

Localidad	Coordenadas
East Side*	36° 07,698' N - 5° 20,477'O
Europa Point*	36° 06,511'N - 5° 20,777'O
Little Bay	36° 06,815' N - 5° 21,025'O
Rosia Bay	36° 07,247'N - 5° 21,154'O
North Mole	36° 08,960' N - 5° 21,890'O
Europort	36° 08,500' N - 5° 21,510' O
Dique San Felipe	36° 09,309'N - 5° 21,671' O
Puente Mayorga*	36° 10,841'N - 5° 24,312'O
Acerinox	36° 10,517'N - 5° 25,397'O
Puerto del Saladillo	36° 07,010'N - 5° 26,141'O
Punta San García*	36° 06,330' N - 5° 25,850'O
La Ballenera	36° 04,990' N - 5° 25,530' O
Punta Carnero*	36° 04,600' N - 5° 25,460' O

normal (W=8848; p=0,1413), previa transformación de los datos con la raíz cuadrada (Fig. 5). La mayor frecuencia aparecía en la clase 5-6 cm, siendo la clase 4-5 cm la que presentaba a continuación una frecuencia más elevada. No se detectaron individuos menores de 2 cm.

Por otro lado, fuera del área de la bahía de Algeciras no se detectaron individuos de la especie ni en escolleras del puerto de la Atunara (La Línea, ya en zona mediterránea), ni en diferentes escolleras en Benalmádena (Málaga), sin embargo se encontró un ejemplar de 13 mm en roquedos naturales del faro de Calaburras (Málaga), dónde se prospectaron unos 500 m de línea de costa tratando de localizar ejemplares en base a citas previas de la especie (GRANDFILS, 1982, GRANDFILS Y VEGA, 1982). Igualmente se detectó otro ejemplar aislado en la escollera exterior de Puerto Banús (Marbella), con una talla entre 2 y 3 cm.

DISCUSIÓN

La población encontrada es de gran interés, pues supone el mayor contingente de *Patella ferruginea* en la península Ibérica. La especie había sido citada en la bahía de Algeciras (localidad de Campamento y Los Roncadillos, entre el Club Naútico de La Línea de la Concepción y la desembocadura del río Guadarranque) por GARCÍA-GÓMEZ (1983), sin embargo, muchas especies han desaparecido en esta zona en los últimos años debido a la elevada presión antrópica que sufre (veR SÁNCHEZ-MOYANO, ESTACIO, GARCÍA-ADIEGO Y GARCÍA-GÓMEZ, 1998). La especie también había sido citada en las costas de Málaga y Granada (punta Chullera, zona de Fuengirola-Calaburras, paseo marítimo de Málaga y en la Punta de la Mona, en la localidad granadina de La Herradura) por GRANDFILS (1982), GRANDFILS Y VEGA (1982) y LUQUE (1986). Así mismo, Barrajón encontró en 1994 un ejemplar vivo en los acantilados de Maro, en el límite entre las provincias de Málaga y Granada (com. pers. en TEMPLADO, 2001). No obstante, TEMPLADO (2001) no encontró ejemplares vivos en la visita realizada en 1995 a las localidades malagueñas dónde había sido citada. Probablemente se traten de poblaciones muy fragmentadas, formadas por escasos ejemplares aislados, difíciles de detectar, puesto que la especie parece que continúa presente en la zona de Málaga, de acuerdo a los ejemplares encontrados en

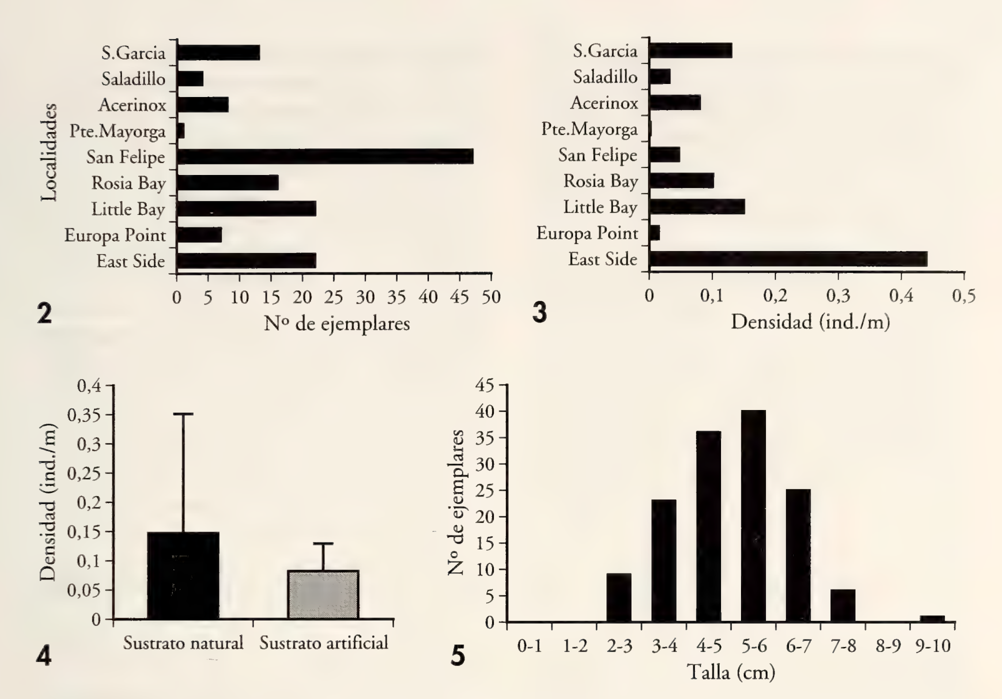


Figura 2. Número de ejemplares de *P. ferruginea* por localidad. Figura 3. Densidad de ejemplares de *P. ferruginea* por localidad. Figura 4. Número de ejemplares de *P. ferruginea* en sustrato natural y artificial. Figura 5. Distribución de frecuencias de talla del conjunto de la población.
Figure 2. Number of individuals of P. ferruginea *per locality. Figure 3. Density of individuals of* P. ferruginea *per locality. Figure 4. Number of individuals of* P. ferruginea *on natural and artifical substrate. Figure 5. Size frequency distribution for the whole population.*

el faro de Calaburras y en Puerto Banús durante el presente estudio. Todo parece indicar que se trata de individuos aislados (ya que se prospectó toda el área adyacente sin detectar más ejemplares), reductos de poblaciones existentes en tiempos recientes o producto del asentamiento de alguna larva procedente de otras localidades del área mediterránea. En este sentido LABOREL-DEGUEN Y LABOREL (1993) sostienen la hipótesis de que ciertos ejemplares relictos de las costas continentales francesas podrían proceder de contingentes larvarios de Córcega. Así, teniendo en cuenta la corriente atlántica superficial que desde el Estrecho se dirige hacia el este paralela a la costa de Málaga a una velocidad de 20 cm/seg. (ARÉVALO Y GARCÍA, 1983), los ejemplares aislados aún presentes en esta área podrían proceder de la población presente en la bahía de Algeciras, alcanzando, en poco menos de seis días, la zona del faro de Calaburras, de acuerdo al modelo de poblaciones donantes (donadoras de contingentes larvarios) frente a poblaciones receptoras (no viables y mantenidas por aportes externos) (BROWN Y KODRICK-BROWN, 1977; HOLT, 1985; PULLIAM, 1988). En la costa oriental de Andalucía la última cita escrita de la especie en la península Ibérica (MORENO, 1992) procede de Cabo de Gata (Almería), aunque los dos ejemplares encontrados desaparecieron posteriormente, y la especie no ha vuelto a ser detectada en las costas de Almería (Moreno, com. pers.). Su ausencia en la parte atlántica (peninsular y africana) del estrecho de Gibraltar ha sido puesta de manifiesto por FISCHER-PIETTE (1959), FA (1998) y GUERRA-GARCÍA, CORZO, ESPINOSA Y GARCÍA-GÓMEZ (2004), lo que corrobora

su área de distribución endémica del Mediterráneo occidental (CRETELLA *ET AL*., 1994). Fuera de Andalucía la especie carece de citas recientes. HIDALGO (1917) la cita en Cadaqués, Fornells y Mahón, no obstante estas citas deberían tomarse con cautela pues dicho autor recibía material y datos de muy diversas fuentes, en muchas ocasiones sin contrastar; si bien en la colección de Locard de 1892 depositada en el Museo Nacional de Historia Natural de París existen ejemplares procedentes de Baleares. En conclusión, se puede afirmar que la presencia de la especie en las costas peninsulares es absolutamente residual, sin presentar poblaciones bien asentadas y reproductivas, perfilándose quizá como única excepción, la población encontrada en el presente estudio, la cual podría constituir una población reproductora. El hecho de que no se hayan detectado juveniles puede deberse al ciclo reproductor anual, ya que la liberación de gametos concluye a final de diciembre (FRENKIEL, 1975), por lo que los juveniles podrían no ser detectados en un recuento hasta varios meses más tarde. Según LABOREL-DEGUEN Y LABOREL (1991b), en estudios llevados a cabo en las costas de Córcega, los juveniles aparecían en los recuentos a finales del verano-principios del otoño, cuando alcanzaban una talla de varios milímetros.

Si bien los ejemplares aparecieron bastante dispersos, el área objeto de estudio no abarcaba en total más de 20 km lineales de costa, y el mayor número de individuos se localiza entre La Línea (espigón de San Felipe) y el peñón de Gibraltar, quizá debido a la mayor disponibilidad de sustrato idóneo para la especie o a la mayor influencia atlántica de la parte occidental de la bahía de Algeciras, con corrientes superficiales atlánticas de entrada (ver FA, 1998). Esta mayor concentración de ejemplares en la parte oriental de la bahía de Algeciras podría posibilitar la fecundación de los huevos (ver TEMPLADO, 2001), permitiendo la persistencia de la población. Este hecho se ve apoyado en la distribución normal de tallas observada, existiendo individuos tanto de clases de talla menores, como mayores. Debido a que se trata de una especie protándrica (inicialmente macho, a partir de unos 25 mm, y luego hembra) (FRENKIEL, 1975; TEMPLADO *ET AL*., 2004), la existencia de distintas clases de talla aseguraría la presencia futura de hembras, por crecimiento y cambio de sexo a partir de los machos existentes. La presencia de una distribución con distintas clases de talla (n=81) es considerada por LABOREL-DEGUEN Y LABOREL (1990) como una población vigorosa y fértil. Otro tipo de distribuciones de tallas, como las encontradas por PARACUELLOS *ET AL*. (2003) en la población de la isla de Alborán, con predominancia de individuos de gran talla (hembras), podría suponer una dificultad para la reproducción, por la carencia de machos, puesto que la mayor parte de los ejemplares serían hembras.

Respecto al sustrato, las mayores densidades aparecen en sustrato natural, sin embargo, en Ceuta son los sustratos artificiales los que albergan las mayores densidades (GUERRA-GARCÍA *ET AL*., 2004). No obstante, hay que tener en cuenta que en el presente estudio no aparecieron diferencias significativas, en parte debido al bajo número de ejemplares, mientras que en Ceuta sí existían diferencias significativas con un número muy superior de ejemplares. En cualquier caso, esta diferencia puede deberse a dos factores, en primer lugar Ceuta presenta una costa más alterada respecto a su fisonomía que Gibraltar, lo que ha propiciado la presencia de gran cantidad de sustratos artificiales quedando los sustratos naturales relegados a zonas muy localizadas. En segundo lugar, los sustratos naturales en Ceuta son preferentemente superficies horizontales poco heterogéneas (obs. pers.) que reciben una gran irradiación solar con respecto a los sustratos artificiales. Sin embargo, en la bahía de Algeciras los sustratos naturales presentaban una mayor heterogeneidad espacial con más zonas de sombra, especialmente en Gibraltar, lo que podría favorecer a la especie. En este sentido WILLIAMS Y

MORRITT (1995) encontraron un mayor estrés térmico con aumento de la mortalidad en enclaves horizontales para el patélido *Cellana grata* en las costas de Hong Kong, y TAKADA (1999) señala una mayor diversidad de gasterópodos intermareales en enclaves umbríos del litoral japonés.

La crítica situación de la especie en las costas peninsulares, unida a la presencia de una población potencialmente reproductora en la bahía de Algeciras, hace urgente un plan de conservación de los ejemplares encontrados para evitar la total extinción de la especie en la península Ibérica, así como la protección de los enclaves de sustrato natural aún no perturbados donde se asienta *P. ferruginea* en el área objeto del estudio. Son necesarios nuevos estudios para conocer la situación exacta de la especie en el sur peninsular, para de esta forma poder diseñar medidas urgentes de conservación y protección de su hábitat.

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The discovery of a radula in a *Dentimargo* species and its taxonomic implications

Descubrimiento de la rádula en una especie de *Dentimargo* y sus implicaciones taxonómicas

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ABSTRACT

The discovery of a comb-like radula in specimens of *Dentimargo* cf. *aureocinctum* (Stearns, 1872) is recorded. The occurrence of such a radula in a presumed non-radulate genus suggests a very close relationship between the genus *Dentimargo* and the genus *Volvarina* Hinds, 1844. This matter invalidates the taxonomic organisation currently accepted within the Marginellinae, and especially that between the Tribes Marginellini and Prunini. The conchological differenciation of *Dentimargo* from the *Volvarina-Dentimargo* common stem is shown to have arisen before the loss of the radula, and this loss is considered to have little taxonomic value within the marginellid gastropods. Due to its high conchological similarity with the type species *D. dentifera* (Lamarck, 1803), *D.* cf. *aureocinctum* is conserved in the genus *Dentimargo*, which is provisionally considered as being composed both of radulate and of non-radulate species.

RESÚMEN

Se reseña el descubrimiento de una rádula en forma de peine en ejemplares de *Dentimargo* cf. *aureocinctum* (Stearns, 1872). La presencia de tal rádula en un género que se considera carecer de la misma indica una relación estrecha entre el género *Dentimargo* y el género *Volvarina* Hinds, 1844. Ello invalida la ordenación taxonómica actualmente aceptada entre los Marginellinae y particularmente entre las Tribus Marginellini y Prunini. Se muestra que la diferenciación conquiológica de *Dentimargo* a partir del estirpe común *Volvarina-Dentimargo* se ha producido antes de la pérdida de la rádula y que esta pérdida es de escaso valor taxonómico en gasterópodos marginéllidos. Considerando su gran semejanza conquiológica con la especie tipo *D. dentifera* (Lamarck, 1803), *D.* cf. *aureocinctum* se mantiene en el género *Dentimargo*, considerando en este tanto especies provistas de rádula cómo careciendo de la misma.

PALABRAS CLAVE: Marginellidae, *Dentimargo, Volvarina*, radula, clasificación supraespecífica, Caribe.
KEY WORDS: Marginellidae, *Dentimargo, Volvarina*, radula, supraspecific organisation, Caribbean.

INTRODUCTION

The generic name *Dentimargo* Cossmann, 1899, based on *Marginella dentifera* Lamarck, 1803 from the Mid-Eocene (Lutetian) of the Paris Basin, is commonly attributed to a series of marginellid species widely distributed in the Recent throughout the tropical and the subtropical zones from littoral to bathyal

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levels. The generic placement in *Dentimargo* is currently used for species with a tall spired, rather biconic, tiny shell, whitish shaded, generally not decorated or poorly banded, and presenting more or less developed labial denticles, the uppermost one being the largest.

Defined on this basis, the genus has been considered to be non-radulate because a radula could not be found in individual species checked respectively by BARNARD (1969), PONDER (1970) and COOVERT (1987). Commenting upon the record of "9 species known or strongly suspected to be non-radulate", COOVERT AND COOVERT (1995) considered the whole genus *Dentimargo* as non-radulate, analogous with the genera *Marginella* Lamarck, 1799 and *Glabella* Swainson, 1840, also claimed to be non-radulate and considered to be closely allied with *Dentimargo*. *Marginella* and *Glabella* are defined on the basis of having larger and thicker shells, generally not bearing a stronger upper labial denticle and exhibiting a richer axial, spiral or ocellate decoration.

COOVERT AND COOVERT (1995) grouped together *Dentimargo*, *Marginella*, *Glabella* and several *Dentimargo*-looking genera in the tribe Marginellini Fleming, 1828, considered to be distinct from the other Marginellinae tribes (Austroginellini COOVERT AND COOVERT 1995 and Prunini COOVERT AND COOVERT, 1995), principally by their rather biconic shell outline and by the claimed lack of a radula (the exception being the genus *Hyalina* Schumacher, 1817, which is said to have lost its radula but placed in the Prunini because of its light cylindrical shell similar to that found in many species of *Volvarina* Hinds, 1844).

BOYER (2001: 160) underlined that "the presumed lack of a radula in the genus *Dentimargo* was controlled only about a restricted number of species and the type species *D. dentifera* Lamarck, 1803, a fossil species apparently represented from the Eocene to the Miocene, was naturally not checked for this character". BOYER (2001: 160) also explained that "numerous marginelliform species from the European Eocene... constitute a poorly differentiated *Volvarina-Dentimargo* complex, in which the "comb-like" radulae (typical of the radulate Prunini species) or their derived forms might be often represented". BOYER (2001: 160) observed that "the loss of the radula in a uniserial rachiglossan group is probably contracted easily, and this derived character seems to have been formed on several occasions in the radiation of the Marginellidae. From that, it is inferred that some *Dentimargo* lineages may have conserved their radula, like some *Volvarina* species may have lost theirs".

The present article is devoted to reporting on the discovery of a comb-like radula in a Caribbean species attributable to *Dentimargo*, and to the first general taxonomic inferences that can be issued from this discovery.

Abbreviations:

ERC: E. Rolán Collection.
FBC: Collection of the author.

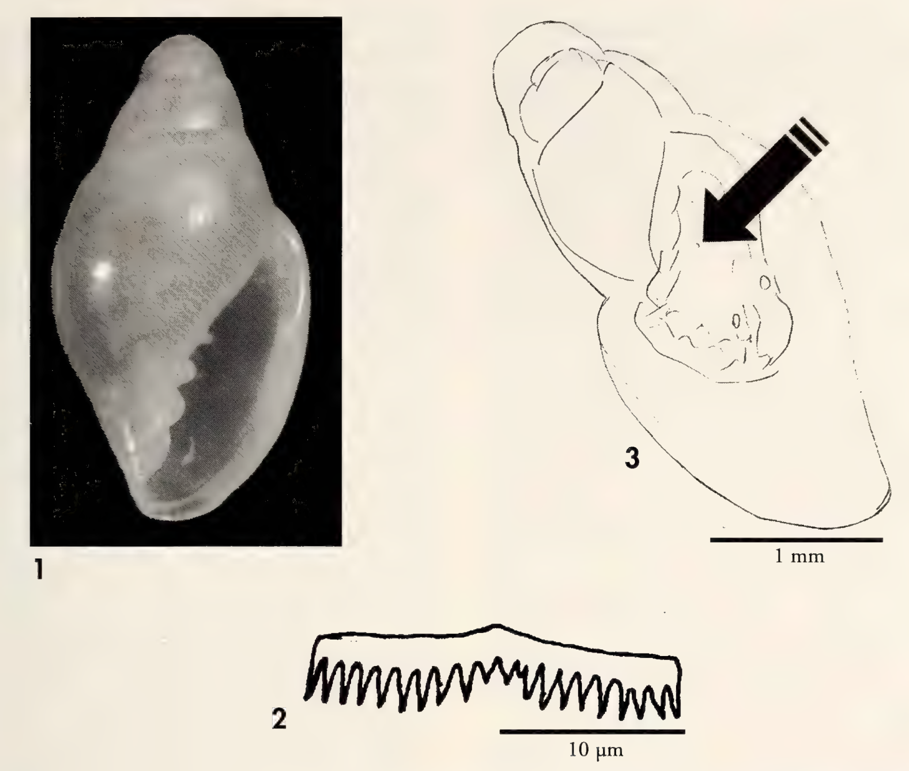
RESULTS

Family MARGINELLIDAE Fleming, 1828
Subfamily MARGINELLINAE Fleming, 1828
Genus *Dentimargo* Cossmann, 1899

Type species by original designation: *Marginella dentifera* Lamarck, 1803.

Dentimargo cf. *aureocinctum* (Stearns, 1872) (Figs. 1-3)

Marginella (Glabella) aureocincta Stearns, 1872: 22 [Type locality: Long Key, Florida].



Figures 1-3. *Dentimargo* cf. *aureocinctum* (Stearns, 1872). 1: shell from Puerto Morelos, Yucatan, height 3.50 mm; 2: radula plate from a juvenile specimen of 3.20 mm of shell length; 3: position of the radula seen by transparency (same specimen as in Figure 1).
Figuras 1-3. Dentimargo *cf.* aureocinctum *(Stearns, 1872). 1: concha de Puerto Morelos, Yucatán, altura 3,50 mm; 2: diente radular de un juvenil de 3,20 mm de longitud de concha; 3: posición de la rádula vista por transparencia (mismo especimen que la Figura 1).*

Type material: Holotype (live collected) in the United States National Museum. Not examined.
Other material examined: Banded form. Florida: 4 adult specimens, 2 juvenile shells, screening in mud and grass, low tide, 2 feet, Tampa Bay (FBC); 2 adult specimens, hand dredged, 1-2 feet, St Andrews Bay (FBC).
White form. Florida: 2 adult shells, Crawl Key (FBC): the squatter of both shells as *D.* cf. *aureocinctum.* Yucatan: 3 adult (Figs. 1, 3) + 1 subadult + 1 juvenile specimens, 1 juvenile shell, Puerto Morelos (FBC, ex-ERC, lot 57 M 1994): all as *D.* cf. *aureocinctum.*

Description: STEARNS (1872: 22).

COOVERT (1987: 35-37) provided a good figure of the type-2 live animal of *D. aureocinctum* from southwest Florida (p. 36, fig. 3) and an extensive description of the animal external anatomy and chromatism. Two specimens were studied, with the adult and subadult specimens shell lengths being 3.88 mm and 4.36 mm respectively. The shell in dorsal view is shown to have a slender, biconic profile, with 2 dark narrow spiral bands on the body whorl and 1 band on the spire whorls.

Radula: COOVERT (1987: 37) did not "attempt to extract radula from this species", but on the basis of the lack of radula displayed by PONDER (1970) in *Dentimargo cairoma* (Brookes, 1924) and of the apparent lack of radula in the Floridian *Dentimargo eburneola* (Conrad, 1834) checked by himself, COOVERT (1987: 37)

considered that it was "quite likely that *D. aureocincta* is also non-radulate".

In the frame of this study, a radula has been extracted from an adult (shell length= 3.50 mm), a subadult (shell length= 3.50 mm) and a juvenile (shell length= 3.20 mm) specimens originating from Yucatan (Puerto Morelos, FBC ex-ERC) and preserved in alcohol.

Adult specimen (Figs. 1, 3): radular extraction R-310, undetermined number of comb-like radular plates bearing 20-21 cusps. The radular ribbon is very small and sub-translucent (see the size of the ribbon at the tip of the black arrow in Figure 3) and it was very difficult to find. The length of this ribbon was 0,256 mm for a shell length of 32 mm. The ratio ribbon length/shell length is of about $^{1}/_{125}$.

Subadult specimen: radular extraction R-609. The radula was observed by transparency through the soft parts but was lost during the extraction process by low dissolving, due to its minute size. The radula was lying within a pouch situated at the distal tip of the extended proboscis. This pouch is interpreted as being the buccal pouch.

Juvenile specimen: radular extraction R-308, 54 comb-like radular plates of 20 µm of width and bearing 20-21 cusps (Fig. 2).

Distribution: The species is said to range from Florida to Yucatan and the Greater Antilles, but the real identity of the tiny littoral *Dentimargo* species recorded from the Greater Antilles remains to be verified, due to the possible presence of several similar species in this area.

Remarks: VOKES AND VOKES (1983) record our species from Yucatan as "*Marginella (Dentimargo) aureocincta immaculata* Dall", and they picture (pl. 18, fig. 7) a shell of 2.9 mm length resembling our specimens closely (Fig. 1). This shell is however thicker, with a strong labrum bearing one produced upper denticle and 4 smaller ones positioned below the mid-part of the inner labrum. Our 3 adult specimens have lighter shells with a thinner labrum, one of them bearing a singular, pronounced upper labial denticle, the rest of the inner labrum being smooth (Fig. 1), whereas the 2 other adult shells show 2 faintly distinct denticles below the pronounced upper one. For all the other features, our specimens perfectly match the one pictured in VOKES AND VOKES (1983).

The shells from Florida show the same general morphology and the same organisation of the columellar plaits and of the denticulated labrum (more commonly 3-4 tiny denticles below the produced upper one, occasionally only 2 tiny denticles or only the larger upper one), but they present a more slender outline with a more pointed spire and a narrower aperture. Most of the shells from Florida bear one honey-orange narrow spiral band on the spire whorls and 2 bands on the body whorl, on a light honey to deep white background colour, but some specimens or populations show a full-white shell (form *immaculata* Dall, 1890). Intergrades between the "banded form" and the "white form" are currently found. The squat form represented in Yucatan (the shell pictured in VOKES AND VOKES, 1983 and our lot from Puerto Morelos) is scarcely found off Florida (FBC: 1 white shell of "squat form" collected together with a white shell of the "slender form" at Crawl Key). No evident intergrades between the "squat form" and the "slender form" are known to us, so the squat-shelled populations are provisionally named as *D.* cf. *aureocinctum*.

The successful finding of a minute radula in *D.* cf. *aureocinctum* has occurred 3 times out of the 3 checkings made in the limited material at hand. Examined by transparency within the alcohol-preserved animal, the radula is verified to be situated at the tip of the proboscis, as well when the proboscis is in extended position (observation in the subadult specimen) than when the proboscis is in retracted position (observation in an adult specimen, Fig. 3). In 2 out of the 3 tentatives, the radular extraction was performed with success and the same minute comb-like radula was documented (Fig. 2). These data allow to leave out the hypothesis giving these radulae as remains of digested preys. The data at hand confirm the radulate status of the species and the belonging of this radula to the "*Volvarina-Prunum* comb-like pattern".

DISCUSSION

The centrally depressed outline of the plates and the smallest cusps placed in median position are unusual features compared to the comb-like radulae known to us from the *Volvarina-Prunum* series (COOVERT AND COOVERT, 1990), which have generally a straight or faintly convex anterior cusped edge, together with uniformly distributed sub-equal small cusps, or sub-equal small cusps with a larger central cusp, or series of sub-equal small cusps separated by isolated larger cusps. However the number of plates like the number and the shape of the cusps in *D.* cf. *aureocinctum* are similar to the pattern found in numerous *Volvarina-Prunum* species. In summary, the radula of *D.* cf. *aureocinctum* is coherent with the range of variability found in the *Volvarina-Prunum* series, more than with the radular patterns found in the *Serrata* series (high number of subequal cusps) or in the *Mesoginella* complex (triangular anterior cusped edge, with a large central cusp and few laterals).

Despite the minute size of the radula found in *D.* cf. *aureocinctum*, there is no reason, in the present state, to consider it as vestigial. For instance, a minute radula with single, narrow plates is also found in the marginellid genus *Hydroginella* known as ectoparasit feeding at night on sleeping fishes (BOUCHET, 1989; JOHNSON, JOHNSON AND JAZWINSKI, 1995). As assumed by JOHNSON *ET AL.* (1995) about the similar case found in *Colubraria*, such minute plates seem to work as cutting out the fish's skin, as precondition of a feeding process by suction of the fish's blood. This point allows to infer that the comb-like radula of *D.* cf. *aureocinctum* may as well be functional despite its minute size. Such a minute size of the radula may also be considered, from an evolutionnary point of view, as an intergrading stage towards the loss of the radula.

Due to its biconical shell outline, its produced upper labial denticle and its faint lower denticles, *D.* cf. *aureocinctum* is demonstrated to be morphologically very similar to the fossil type species *D. dentifera*. For this reason its placement in *Dentimargo* sensu stricto is conservatively proposed as the most parsimonious solution.

However, it must be underlined that other *Dentimargo*-shelled species closely matching with *D. dentifera* [like for instance the New Zealand *D. cairoma* (Brookes, 1924) studied by PONDER (1970), the Floridian *D. eburneola* (Conrad, 1834) checked by COOVERT (1987) or the Mascarene *D. pumila* (Redfield, 1870) checked by the author] really do seem to be devoid of a radula. The matter signifies that the occurrence of the radula is represented as a heterogeneous character within the *Dentimargo* series and that it cannot be used as a diagnosis feature for the genus. In other words, *Dentimargo* is provisionally considered as being composed both of radulate and of non-radulate species.

As a direct consequence, the loss of the radula is likely to be of low discriminating value in marginellid gastropods. Besides, it must be emphasized that the loss of the radula may have arisen independantly in different lineages. This point leads to a reconsideration not only about the phyletic unity of *Dentimargo*, but also about the degree of relationship occurring between *Dentimargo* and the supposed non-radulate genera *Marginella* and *Glabella*.

On the other hand, the *Volvarina*-patterned radula found in *D.* cf. *aureocinctum* proves that the conchological distinction between *Dentimargo* and *Volvarina* (not well marked in the Eocene, but more clearly displayed in the Recent) took place before the loss of the radula, at least in one of the *Dentimargo* lineages. Secondarily, the radula found in *D.* cf. *aureocinctum* suggests a very close relationship between *Volvarina* and *Dentimargo*, without care about the order of disbranching from a comb-like radulate ancestor.

The discovery of a radula in the supposed non-radulate group *Dentimargo* and the inferred phyletic proximity between *Dentimargo* and *Volvarina* lead

to the assumption that the generic diagnosis and the supraspecific distinctions currently accepted within the Marginellinae remain mainly non-operative, in particular about the separation between the Prunini and the Marginellini, and about their respective composition.

The matter requires a general reassessment of the organisation of the Marginellinae, based on a new documentation provided by extensive comparisons concerning the morphologic disparity occurring in fossil and Recent shell material, and by correlative researches about the radula. Additional comparisons concerning internal anatomy and DNA patterns may prove to be more decisive for a clear reconstitution of the disbranchings within the subfamily.

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About a sibling species of *Mitrella minor* (Scacchi, 1836)

Sobre una especie gemela de *Mitrella minor* (Scacchi, 1836)

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RESUMEN

Se revisa *Columbella minor* Scacchi, 1836 en el género *Mitrella* Risso, 1826, basándose en la figura y descripción original, así como en el estudio de materialdel Mediterráneo y Atlántico próximo. Se designa un neotipo de *C. minor.* Este taxon tiene prioridad sobre el nombre más antiguo *Mangelia vitrea* Risso, 1826 siguiendo el artículo 23.9 de el Código de Nomenclatura Zoológica. Se discuten la variabilidad en la morfología y decoración de la concha y el cromatismo del animal.

Una especie gemela, que se extiende desde la Isla de Alborán al norte de Senegal, se describe como *Mitrella hernandezi* spec. nov. Su diagnosis está ligada en primer lugar a una protoconcha grande y pupoide en vez de la castaña y puntiaguda de *M. minor*, y en un periostraco ténue pero con un aspecto enrejado, en vez del fuerte y toscamente arrugado presente en *M. minor.*

ABSTRACT

Columbella minor Scacchi, 1836 is revised in the genus *Mitrella* Risso, 1826, on the basis of its original description and figure, and of the study of shell material from Mediterranean and the nearby Atlantic. A neotype of *C. minor* is designated. *C. minor* takes priority on the older name *Mangelia vitrea* Risso, 1826 on the basis of the article 23.9 of the Code of Zoological Nomenclature. The variability of the shell morphology, of the shell decoration and of the animal chromatism is discussed.

A sibling species ranging from Alboran Island to Northern Senegal is described as *Mitrella hernandezi* sp. nov. Its principal diagnostic features lie in a large white pupoid protoconch instead of a small brown pointed one in *M. minor*, and in a thin lattice-patterned periostracum instead of a thick coarsely wrinckled one in *M. minor.*

KEY WORDS: Columbellidae, *Mitrella*, *Columbellopsis*, sibling species, Mediterranean, Lusitanian Province, Northwest Africa.

PALABRAS CLAVE: Columbellidae, *Mitrella*, *Columbellopsis*, especies gemelas, Mediterráneo, Lusitanica Provincia, África del noroeste.

INTRODUCTION

The species currently named in the literature as *Mitrella minor* (Scacchi, 1836) is known to be one of the most common and widespread of the columbellid species from the Lusitanian Province (LUQUE, 1986a; POPPE AND GOTO, 1991).

The species is said to range at lower infralittoral and at circalittoral levels

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along the Mediterranean Sea (HIDALGO, 1917), the Atlantic side of the Iberian Peninsula (NOBRE, 1940; ROLÁN, 1983) and the Canary Islands (NORDSIECK AND GARCIA-TALAVERA, 1979 as *M. svelta* Kobelt, 1901; HERNÁNDEZ-OTERO AND HERNÁNDEZ GARCÍA, 2003). Currently placed in the genus *Mitrella*, Risso, 1826 [Type species by subsequent designation (COX, 1927: 28) *Mitrella flaminea* Risso, 1826 = *Mitrella scripta* (Linnaeus, 1758)], *Columbella minor* Scacchi is the type species of the genus *Columbellopsis* Bucquoy, Dautzenberg and Dollfus, 1882 (original designation).

LUQUE (1986a) noted that the populations of *M. minor* ranging off the Canary Islands present a rich shell decoration of small light dots on a dark chestnut ground and of darker subsutural marks, to be compared with the uniform horny brown background found in the populations from Mediterranean and from the nearby Atlantic (range extension said to lie from Mogador to Vigo). LUQUE (1986a) also recorded the occurrence of a pinkish aperture with white labial denticles and of about 10 striae on the base of the last whorl in the populations from the Canary Islands, to be compared with the whitish aperture and the 12-14 striae found in the northern populations. Due to the very limited amount of shells checked from the Canary Islands (1 from La Palma and 2 from Tenerife), LUQUE (1986a) said to be unable to confirm the specific identity of the Canarian population.

The study of a large material from the whole Lusitanian Province allows us to state on the distinct specific identity of the Canarian morph, and to describe it as a new species.

MATERIAL AND METHODS

The shells studied come principally from the MNHN collections and from the private collections of S. Gori, J. M. Hernández, P. Micali, C. Mifsud, A. Peñas and F. Swinnen. Live animals have been studied from Vigo, Algeciras and Gran Canaria.

The term of "sibling species" is used in its trivial meaning of "very similar species" (KNOWLTON, 1993).

Abbreviations:

AMNH American Museum of Natural History, New York
MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Muséum national d'Histoire naturelle, Paris
MNHST Museo de la Naturaleza y el Hombre, Santa Cruz de Tenerife
NHM The Natural History Museum, London
ZSM Zoologische Staatsammlung Muenchen, Munich
CAL collection A. Locard (MNHN)
CAP collection A. Peñas
CCM collection C. Mifsud
CER collection E. Rolán
CFB collection F. Boyer
CFS collection F. Swinnen
CJH collection J. Hernández
CPM collection P. Micali
CSG collection S. Gori
s shell
sp specimen
stn station

TAXONOMY

Genus *Mitrella* Risso, 1826.

Type species by subsequent designation (Cox, 1927): *Mitrella flaminea* Risso, 1826 [= *Mitrella scripta* (Linné, 1758)].

Mitrella minor (Scacchi, 1836) (Figs. 1-7, 13, 18-24, 29-31, 38, 42, 43)

Mangelia vitrea Risso, 1826. *Hist. Nat. Eur. Mérid.*: p. 222-223, no fig.



Figures 1-3. *Mangelia vitrea.* 1, 2: holotype, L = 8.6 mm (MNHN); 3: protoconch of the holotype.
Figuras 1-3. Mangelia vitrea. 1, 2: holotipo, L = 8,6 mm (MNHN); 3: protoconcha del holotipo.

Buccinum politum Cantraine, 1835, non-(Lamarck, 1822) nec-(Basterot, 1825). *Bull. Ac. Roy. Sci. Bruxelles*, 11: 17, no fig.
Columbella minor Scacchi, 1836. *Catal. Conchy. regni Neapolitani.*: p. 10, fig. 11.
Buccinum scacchi Calcara, 1840. *Monog. dei Gen. Claus. e Bulim.*: p. 51, no fig.

Type material: The original type material of *Columbella minor* Scacchi is lost, destroyed in Napoli during the Second World War (CRETELLA, CROVATO, CROVATO, FASULO AND TOSCANO, 2005).
A specimen from "Punta Pagliarolo, Salerno, 35 m" (Fig. 21), from the collection J. Hernández, originating from the vicinity of Napoli and matching the original description of the species in all respects, including the reticulated colour pattern of the shell, is designated as neotype of *Mitrella minor*. The shell measurements are 9.47 x 3.68 mm. This neotype is deposited in MNHN.
Other material examined: A supposed syntype of *Mangelia vitrea* Risso, 1826 (MNHN), 8.6 x 3 mm (Figs. 1-3), assumed to originate from the coasts of the French Riviera.
Mediterranean: 1 s, Ras il Wata, Malta, 80-100 m (CFS); 3 sp, Ras il Raheb, Malta, 120 m (CFS); 15 sp, Gneja Bay, Malta,130 m (CCM) (Figs. 31, 42, 43); 1sp, 3 s, Siracusa, Sicily, 100 m (CJH) (Figs. 24, 30); 1 s, Siracusa, 35 m (CFS); 2 s, Capo Asporano, Sicily (CFS); 32 s, Villaggio Pace, Messina, 10-30 m (CPM) (Fig. 22); 2 sp, Punta Faro, Messina, 30 m (CPM); 2 sp, Scilla, Messina, 50-70 m (CPM) (Fig. 20); 1 sp, Capo S. Alessio, 7-8 m (CFS); 1 s, Sowona (CFS); 2 s, Boccodasse, (CFS); 1 s, Infreschi, Marina di Camerota, 30 m, (CPM); 3 s, Ponza Island, South Thyrrenian, 600 m (CPM); 2 s, Capri (CAL, MNHN); 3 s, Secca Murelle, Latium, 23-27 m (CPM); 6 sp, Vada, Leghorn, 80-120 m (CSG); 2 s, Ajaccio, Corsica (CAL, MNHN) (Fig. 23); 2 s, St Raphael (CAL, MNHN); 2 s, St Tropez (CAL, MNHN); 2 s, Toulon (CAL, MNHN); 2 s, Bandol (CAL, MNHN); 2 s, Le Grau du Roi (CAL, MNHN); 1 s, Oran (CAL, MNHN); 45 s, Vilassar del Mar, 20-60 m (CAP); 1 s, Puerto de Solles, Mallorca, 90 m (CFS); 1 s, Calahonda (Málaga), beach (MNHN); 3 s, Málaga (CAP); 6 s, Rincón de la Victoria, Málaga, 20-40 m (MNHN); 6 s, Málaga, paseo marítimo, 20-40 m (MNHN); 2 sp, Torreguadiaro, Sotogrande nets, circalittoral, (MNHN); 3 sp, Marbella, nets (MNHN); 3 s, Marbella, 30-40 m (CFB); 7 s, Marbella, beach (MNHN); 3 sp, Marbella, 70-80 m (CJH) (Figs. 4, 7, 13, 18, 19, 29, 38); 3 sp, Algeciras, La Línea, 18-22 m (CFB); 2 sp, M'diq, Northern Morocco, nets (MNHN); 21 s, Ceuta, beach in the harbour (MNHN); 2 s, Ceuta South, Anse Almadrabe, 35° 52.5′ N, 05° 10.0′ W, 35-45 m (MNHN); 1 sp, Ceuta, 35° 53′ N, 05° 17′-05° 19′ W, 50 m (MNHN); 4 s, Ceuta North,

Playa Benitez, 35° 54.6′ N, 05° 20.0′ W, 15-25 m (MNHN); 1 sp, Ceuta Restinga (CJH); 6 s, Alborán Island, 60-250 m (MNCN).
North East Atlantic: 1 s Tanger, market (MNHN); 4 s Tanger, beach (MNHN); 1 s, Cap Spartel, North Morocco, 100 m (MNHN); 5 sp, Algarve, Burgau, 37° 03.4′ N, 08° 46.30′ W, 35 m (MNHN); 4 s, Tavira, Pedro do Barril, 25 m (MNHN); 2 sp, Algarve, Baia Belixe, 37° 00.0′ N, 08° 58.0′ W, 23 m (MNHN); 10 sp, 5 juv, Algarve, between Salema and Praia de Luz, 70 m (MNHN); 1 sp, Algarve, between Sagres and Faro, 40-50 m (MNHN); 2 sp Algarve, Porto de Sagres, 37° 00.6′ N, 08° 55.6′ W, 9-15 m (MNHN); 1 juv, Algarve, Sagres, Punta Balecira, 17-23 m (MNHN); 2 s, Lagos, Portugal (CFS); 8 s, Ria de Vigo, 30-40 m (CER) (Figs. 5, 6); 1 s, Bouzas, Vigo, 20 m (CER); 32 sp, Cambados, Ría de Arousa, Galicia (collection J. Horro); 2 sp, Dakhla, Western Sahara, 50-60 m (CFB).
Type locality: Gulf of Napoli.

Original descriptions: In Risso (1826), as *Mangelia vitrea*: "584. *M. vitrea* (N.), M. vitrée. *M. Testa glaberrima, nitidissima, vitrea; apertura lucida*. Coq. très lisse, fort luisante, vitrée; à ouverture translucide. Long. 0.010. Séj. Régions coralligènes. App. printemps".

No original figure. Supposed syntype MNHN in Figures 1-3.

In Scacchi (1836), as *Columbella minor: "Columbella… minor Nobis (12).*

Testa parva, laevi, albo-flavescente, lineolis fulvis obsolote reticula; anfractibus octo, ultimo in medio pallidiore; in speciminibus perfectis epidermide flavescente per lungum striata obtecta; columella oblique striata, ultra labrum parum porrecta; labro crassiusculo interne denticulato. Alta lin: 4. Columbellae flamine ac similis, sed minor, gracilior, et columella productiore. In sinu Neapolitano rara, et Inarimes insulae fossilis. Inspice fig. 11".

Original type material lost. Neotype MNHN in Figure 21.

Complementary description: Illustrations in Rolán (1983), Luque (1986a), Poppe and Goto (1991) and Giannuzzi-Savelli, Pulsateri, Palmeri and Ebreo (2003).

The pointed brown protoconch (Figs. 3, 7, 18, 19, 29-31, 38) does not show an evident separation from the teleoconch, but under magnification it is suggested to have 1.75 whorls, and the diameter of the nucleus is about 260-320 µm. The "nucleus width/base width ratio" of the protoconch is of about $^1/_2$. A more or less depressed zone lies below the beginning of the nucleus, as clearly visible in Figure 31. In few cases, the protoconch is rather bulbous (Figs. 23, 24) instead of pointed, and/or whitish (Fig. 23) instead of brown. Even the protoconch displayed in Fig. 23, assumed to result from a teratologic event, holds a "nucleus width/base width ratio" of $^1/_2$.

The very high spire shows generally straight or very faintly concave sides and more or less turriculated whorls. The shape of the aperture is somewhat variable, from rectangular to losangic, often rather wide with a columellar border faintly angled, columellar folds from well-marked to absent, outer lip moderately convex to moderately angled, and siphonal canal rather short and widening. The spiral striae at the base of the last whorl range from 9 to 14, more currently being 12-13. The ground colour is creamy white to horny beige with wide tan-brown spiral bands covering most of the whorls. A lighter narrow spiral blank at the mid part of the last whorl often separates 2 wide brown zones. In few shells, mainly coming from Central and Southern Mediterranean, the brown spiral bands tend to be fragmented in brown marks making a stripped (Fig. 20), a reticulated (Figs. 21, 22) or a flamed pattern (Figs. 23, 24).

The length of the adult shells ranges from 8 mm up to 13 mm.

The periostracum is thick, with coarse spaced axial wrinkles giving a "waffle" appearance to the surface (Figs. 5, 6, 42, 43).

The colour pattern of the soft parts shows as somewhat variable. The main features are displayed by Rolán and Otero-Schmitt (1996) after an animal from Vigo. Two animals examined from Algeciras by the first author presented



Figures 4-7. *Mitrella minor.* 4: specimen from Marbella, 70-80 m, 13 mm (CJH); 5, 6: specimens from the Ría de Vigo, 9.1 mm and 9.4 mm (CER); 7: protoconch of the specimen from Figure 4. Figures 8-11. *Mitrella hernandezi.* 8: holotype, NW Gran Canaria, 11.0 mm (MNCN); 9: paratype, 10.5 mm, (CJH); 10: specimen from off Banc d'Arguin, Mauritania, 80 m, 12.7 mm (CJH); 11: protoconch of the holotype.

Figuras 4-7. Mitrella minor. *4: ejemplar de Marbella, 70-80 m, 13 mm (CJH); 5, 6: ejemplares de la Ría de Vigo, 9,1 mm and 9,4 mm (CER); 7: protoconcha del ejemplar de la Figura 4. Figuras 8-11.* Mitrella hernandezi. *8: holotipo, NW Gran Canaria, 11,0 mm (MNCN); 9: paratipo, 10.5 mm, (CJH); 10: ejemplar del Banc d'Arguin, Mauritania, 80 m, 12,7 mm (CJH); 11: protoconcha del holotipo.*

the same general pattern: underside and periphery of the sole whitish, column of the foot shaded on its sides by large blackish zones on a whitish grey ground, front zone whitish grey, back zone blackish; head, top of the neck and tentacles black, except around the eyes, the underside and the tip of the tentacles which are whitish; siphon blackish, all the whitish or whitish grey zones being flecked by deep white tiny dots. The operculum is hyalinous yellow.

The radula is summarized in LUQUE (1986a, pl. 3, fig. f).

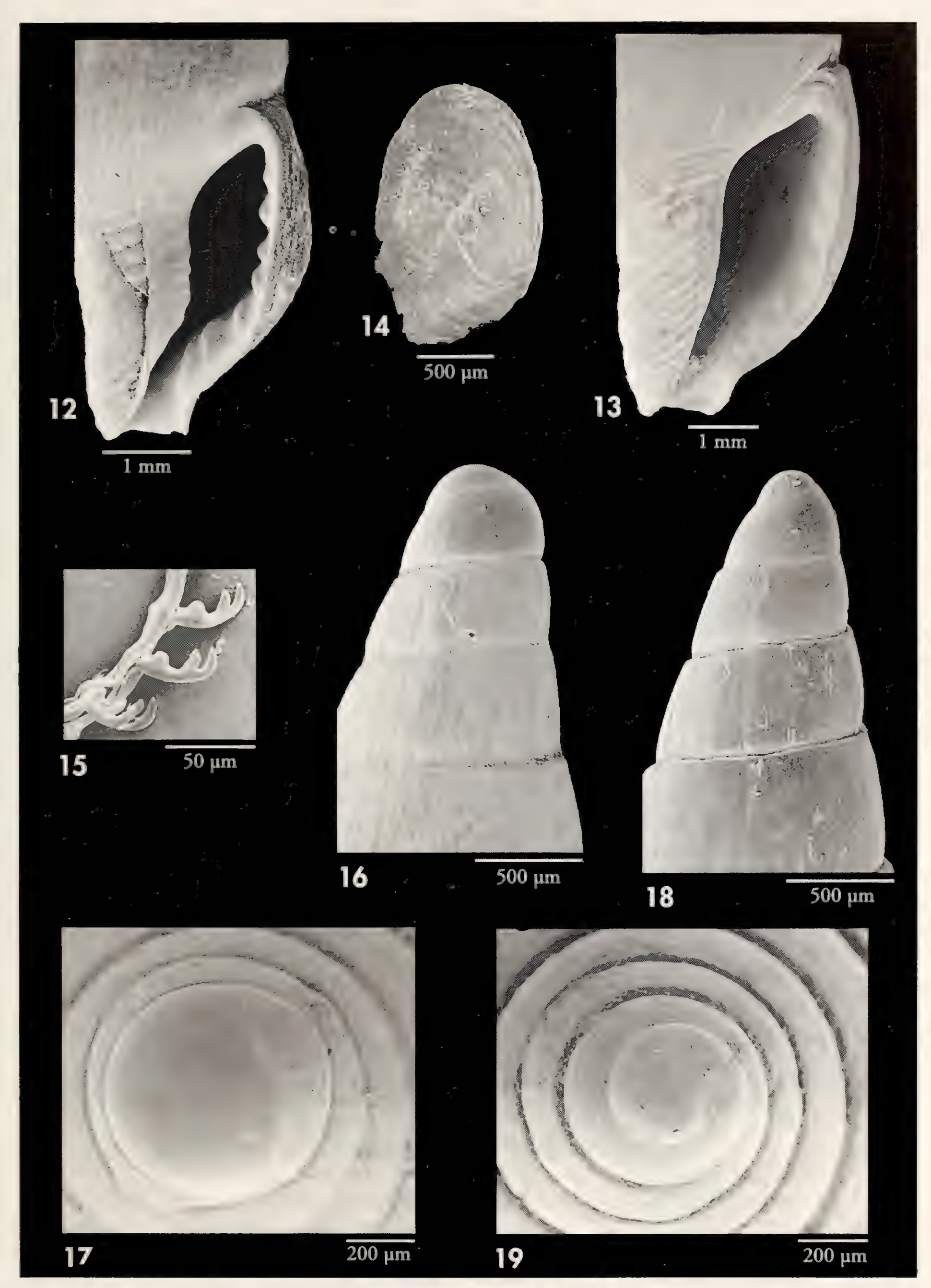
Distribution: The whole Mediterranean and the nearby Atlantic from the Straight of Gibraltar to Galicia. Live specimens from 7 m to 130 m. The occurrence along the Atlantic coasts of the Northern Morocco is probable, but it remains to be fully documented. The occurrence off Western Sahara remains dubious, as only one record is known from this area (2 sp, Dakhla, CFB), possibly coming from accidental mixing of shells from Mediterranean and from Western Sahara. Not represented in the Canary Islands.

Remarks: VAN AARTSEN, MENKHORST AND GITTENBERGER (1984: 80) noted that *Columbellopsis* has been considered later by its authors as falling in synonymy with *Atilia* H. and A. Adams, 1853, and they claimed that the "poorly known boundaries between species in this group" did not allow "to place *M. minor* in a subgenus of its own".

VAN AARTSEN *ET AL.* (1984) did not care with the arguments displayed by RADWIN (1978: 331-332), who shows that the designation of *Mitrella minor* Scacchi as type species of *Atilia* was invalid, that the species has been removed from *Atilia* by the next reviewer and that *Columbellopsis* can be used as brother genus of *Mitrella* in the present state, being represented by its own peculiar shell features besides *Mitrella* as far back as the early Eocene. These consistent arguments will be to take in consideration in a taxonomic revision of the eclectic genus *Mitrella*, but the matter requires a general analysis of the phylogeny prevailing about the different species group currently lumpered within *Mitrella* s.l. In the wait of such a revision, we feel more appropriate to keep conservatively *Columbella minor* in the genus *Mitrella*.

Despite its status of ubiquitous species, few synonyms occurred and the specific name of *C. minor* prevailed in the literature since the Scacchi's description. *Buccinum politum* Cantraine, 1835, which is a preoccupied name, was proved to be a nomen dubium by VAN AARTSEN *ET AL.* (1984), *Buccinum minus* Philippi, 1836 was a misspelling of the Scacchi's name, and *Buccinum scacchi* Calcara, 1840 was apparently the last name proposed as referring to the species. CALCARA (1845: 40) considered apparently its *Buccinum scacchi* Calcara, 1840 as synonym of *Columbella minor* Scacchi, 1836.

The elusive name of *Mangelia vitrea* Risso, 1826, neglected in the literature due both to its deceitful original generic attribution and to its poorly descriptive original definition, is considered herein as an objective older synonym of *C. minor*, on the ground of the supposed syntype stored in MNHN. We must express however some reserves about the status of this syntype and about the identity of the taxon *Mangelia vitrea*. These reserves lie first in the fact that ARNAUD (1977) did not recognize any material referring to *M. vitrea* in MNHN at the time of his study (type said to be lost), and that the subsequent determination of the so-said syntype of *M. vitrea* was made by the MNHN curator on the basis of a label from the hand of A. Risso ("*Mangelia vitrea* Risso") joined to the supposed syntype but without further correlation between this label and the shell specimen. Secondly, the figure of *M. vitrea* pictured by P. Gény in ARNAUD (1977: pl. 11, fig. 201) and supposed to represent a shell labelled under this name in the Risso's collection, does not match really the shell morphology of the supposed MNHN syntype. The figure given by P. Gény presents a shell with a narrower, more slender and more acute spire, and a longer siphonal canal with a well-marked notch, the general



Figures 12, 14-17. *Mitrella hernandezi,* paratype (CER). 12: detail of the aperture; 14: operculum; 15: radula; 16, 17: protoconch of the shell from Fig. 12. Figures 13, 18, 19. *Mitrella minor,* specimen from Marbella, 70-80 m, (CJH). 13: detail of the aperture; 18, 19: protoconch of the shell from Figure 13.

Figuras 12, 14-17. Mitrella hernandezi, *paratipo (CER). 12: detalle de la abertura; 14: opérculo; 15: rádula; 16, 17: protoconcha de la concha de la Fig. 12. Figuras 13, 18, 19.* Mitrella minor, *ejemplar de Marbella, 70-80 m (CJH). 13: detalle de la abertura; 18, 19: protoconcha de la concha de la Figura 13.*

outline suggesting a turrid species. On the other hand, the poor original description of *M. vitrea* matches more closely the supposed MNHN syntype than any turrid species from Mediterranean known to us. Any of these arguments does not allow by itself to define *M. vitrea* as a dubious species.

The junior name *Columbella minor* Scacchi, 1836 is considered to have priority on the older name *Mangelia vitrea* Risso, 1826 on the ground of the article 23.9 of the Code of Zoological Nomenclature (Precedence Inversion): *M. vitrea* (probably considered as a nomen dubium by the subsequent authors) was apparently not used in the literature after 1899, and *C. minor* was used in more than 25 works (generally under the genus *Mitrella*), published by more than 10 authors during the last 50 years along a period of more than 10 years. References and the pages where the species was mentioned are the following: PASTEUR-HUMBERT (1962: 159), NORDSIECK (1968: 124), PARENZAN (1970: 171), SCHIRÒ (1979: 7), SABELLI AND SPADA (1981: 1), TERRENI (1981: 35), ROLÁN (1983: 248), VAN AARTSEN *ET AL.* (1984: 37), BRUSCHI, CEPPODOMO, GALLI AND PIANI (1985: 25), LUQUE (1986a: 234), LUQUE (1986b: 91), CASTAÑO, CIVIS AND GONZÁLEZ DELGADO (1988: 178), SABELLI, GIANNUZZI-SAVELLI AND BEDULLI (1990: 206), POPPE AND GOTO (1991: 152), ARDUINO, LOCATELLI, ORLANDO AND REPETTO (1995: 82), ROLÁN AND OTERO SCHMITT (1996: 100), GIRIBET AND PEÑAS (1997: 52), MACEDO, MACEDO AND BORGES (1999: 204), ARDOVINI AND COSSIGNANI (1999: 62), BOUCHET, LE RENARD AND GOFAS (2001: 194), GIANNUZZI-SAVELLI *ET AL.* (2003: 256), HERNÁNDEZ-OTERO AND HERNÁNDEZ GARCÍA (2003: 84), ÖZTURK, BUZZURO AND AVNI BENLI (2004: 58), ARDOVINI AND COSSIGNANI (2004: 166), POGGIANI, MATTIOLI AND MICALI (2004: 116), and CRETELLA *ET AL.* (2005: 120).

This solution is proposed for the benefit of the stability of the nomenclature.

Mitrella minor does not show evident geographic forms. However, the specimens from Vigo (Figs. 5, 6) have smaller and darker shell's than those from Mediterranean, and they seem to have a more prominent periostracum (compare with a specimen from Malta in Figures 42 and 43). The populations from the coasts of Portugal and Spain, also those from Southern France and from the Italian Liguria, mainly show an uniform tan-brown shell colour pattern, sometimes dull creamy-white, whereas the populations from Central and Southern Mediterranean (Corsica, Western Italy from Toscana to Sicily, North Africa coasts) present most frequently a "flamed", "reticulated" or "slack check-patterned" shell decoration (from the words of SCACCHI, 1836), corresponding to the original description of M. *minor*. A white vitreous to hyalinous form with browny to greyish protoconchs, which matches the original description of *Mangelia vitrea* (original locality belonging probably to the French Riviera), seems also to be more frequent in Central Mediterranean [specimens observed from Leghorn (CSG) and from Siracusa (CJH)]. Full tan-brown shells and intergrades are also found off Western Italy, and full tan-brown shells are found off Malta.

The noticeable variations in the protoconch morphology and background colour pictured herein (Figs. 3, 7, 18, 19, 29-31, 38) do not correlate with the variations observed in the morphology and in the decoration of the shells (Figs. 1, 2, 4-6, 13, 20-24, 42). One shell from Ajaccio, Corsica (Fig. 23) is comparable to the following species for its whitish bulbous protoconch, but it is provisionally named as *M.* cf. *minor*, due to the fact that this protoconch seems to result from a teratologic event rather than to express a distinctive specific feature. The wide aperture and the colour pattern of broad flames occurring in the shell pictured in Figure 23 are coherent with the variability observed in *M. minor*, but not with the variability observed in the following species. Further inquiries will verify if the distribution of the following species reaches Corsica and if the shell pictured in Figure 23 really belongs to *M. minor.*



Figures 20-22, 24. *Mitrella minor*. 20: specimen from Scilla, Messina, 50-70 m, 10.8 mm (CPM); 21: neotype, specimen from Punta Pagliarolo, Salerno, 35 m, 9.47 mm (MNHN, ex-CJH); 22: shell from Villaggio Pace, Messina, 10-30 m, 9.5 mm (CPM); 24: specimen from Siracusa, Sicilia, 100 m, 8.5 mm (CJH). Figure 23. *Mitrella* cf. *minor*, shell from off Ajaccio, Corsica, 11 mm (MNHN). Figures 25-28. *Mitrella hernandezi*. 25: specimen from Alboran Island, 20 m, 9.8 mm (CJH); 26: specimen from Alboran Island, 20 m, 10.20 mm (CJH); 27: specimen from Alboran Island, 20 m, 9.25 mm (CJH); 28: specimen from La Manchita, NW Gran Canaria, 35 m, 9.5 mm (CJH).
Figuras 20-22, 24. Mitrella minor. *20: ejemplar de Scilla, Messina, 50-70 m, 10,8 mm (CPM); 21: neotipo, ejemplar de Punta Paglialoro, Salerno, 35 m, 9,47 mm (MNHN, ex-CJH); 22: concha de Villaggio Pace, Messina, 10-30 m, 9,5 mm (CPM); 24: ejemplar de Siracusa, Sicilia, 100 m, 8,5 mm (CJH). Figura 23.* Mitrella cf. minor, *concha de Ajaccio, Corsica, 11 mm (MNHN). Figuras 25-28.* Mitrella hernandezi. *25: ejemplar de la isla de Alborán, 20 m, 9,8 mm (CJH); 26: ejemplar de la isla de Alborán, 20 m, 10,2 mm (CJH); 27: ejemplar de la isla de Alborán, 20 m, 9,25 mm (CJH); 28: ejemplar de La Manchita, NO Gran Canaria, 35 m, 9,5 mm (CJH).*

Mitrella hernandezi sp. nov. (Figs. 8-12, 14-17, 25-28, 32-37, 39-41)

Type material: Holotype (Figs. 8, 11) in MNCN (15.05/46626); paratypes in AMNH (1), NHM (1), MNHN (1), ZSM (1), MNHST (1), CJH (20) (Fig.9), CER (2) (Figs 12, 14-17), CFB (2), all from the type locality.

Other material examined: Mediterranean: 5 sp, Alborán Island, 20 m (CJH) (Figs. 25-27, 32-34).

Canary Islands: 2 s, Gran Canaria (CJH); 43 s, off NW Gran Canaria, 170 m, (CJH); 24 sp, Barranco de Guayedra, NW Gran Canaria (CJH); 2 s, NW Gran Canaria, 150 m (CJH) (Figs. 35, 36); 2 s, Gran Canaria (CJH); 4 sp, NW Gran Canaria, 302 m (CJH); 8 s, La Manchita, Gran Canaria, 35 m (CJH) (Fig. 28); 5 sp, NW Gran Canaria, 150-200 m (CFB); 5 s, off Las Nieves, NW Gran Canaria, 34 m (CFB); 1 s off San Cristobal, NE Gran Canaria, 40-60 m (CJH).

Northwest Africa: 3 s, south of Cape Bojador, 25° 40′ N, 15° 03′4 W, 100 m (CSG); 1 s, Western Sahara (CFS); 1 sp, Western Sahara, 30 m (CJH); 6 sp, Western Sahara, 30-40 m (CJH); 10 sp, Western Sahara, 60 m (CJH) (Figs. 37, 39-41); 2 sp, Western Sahara, 40 m (CJH); 15 sp, 2 s, Western Sahara, 30 m (CJH); 6 s, Western Sahara, 60 m (CJH); 1 s, 22° 00′ N, 17° 22′ W (CJH); 2 sp, Dakhla, Western Sahara, 50-60 m (CFB); 5 sp, Western Sahara, 30-40 m (CFB); 3 s, Western Sahara, 50-60 m (CFB); 1 s, Meteor stn 36, 21° 19.5′ N, 17° 13.1′ W, 58 m (ZSM); 1 sp, 9 s, off Banc d'Arguin, Mauritania, 80 m (CJH) (Fig. 10); 1 s, Lompoul, Northern Senegal, 150 m (CFB); 1 s, Meteor stn 60.77, 17° 17′ N, 16° 30′ W, 85 m (MNHN); 1 s, NO "N'Diago" 1981 stn 119, 18° 36′ N, 16° 28′ W, 70 m (MNHN); 1 s, NO "N'Diago" 1981 stn 103, 18° 48′ N, 16° 22′ W, 28 m (MNHN); 1 s, NO "N'Diago" 1981 stn 248, 17° 54′ N, 16° 20′ W, 76 m (MNHN); 1 s, NO "N'Diago" 1981 stn 232, 17° 42′ N, 16° 05′ W, 12 m (MNHN); 1 s, Dakar harbour, 11-12 m (MNHN); 1 s, NO "N'Diago" 1981, stn 240, 17° 48′ N, 16° 24′ W, 38 m (MNHN); 1 s, region of Dakar, 14° 19′ N, 17° 32′ W, 132 m (MNHN); 1 sp, 14 s, region of Dakar, 14° 24′ N, 17° 23′ W, 78 m (MNHN); 1 s, Dakar, 14° 51′ N, 17° 30′ W, 165-180 m (MNHN); 1 s, Dakar, 14° 52′ N, 17° 30′ W, 140-150 m (MNHN); 2 s, NO "N'Diago" 1981 stn 63, 20° 42′ N, 17° 21′ W, 43 m (MNHN); 1 s, 1 fragment, region of Dakar, 20° 58′ N, 17° 37′ W, 110 m (MNHN); 8 s, South of Gorée, 48-50 m (MNHN); 1 s, South of Gorée, 95-98 m (MNHN).

Type locality: Off Northwest Gran Canaria, 50-170 m.

Etymology: The specific name is dedicated to José María Hernández, Canarian malacologist devoting to the study of the molluscan fauna from the Southern Lusitanian Province.

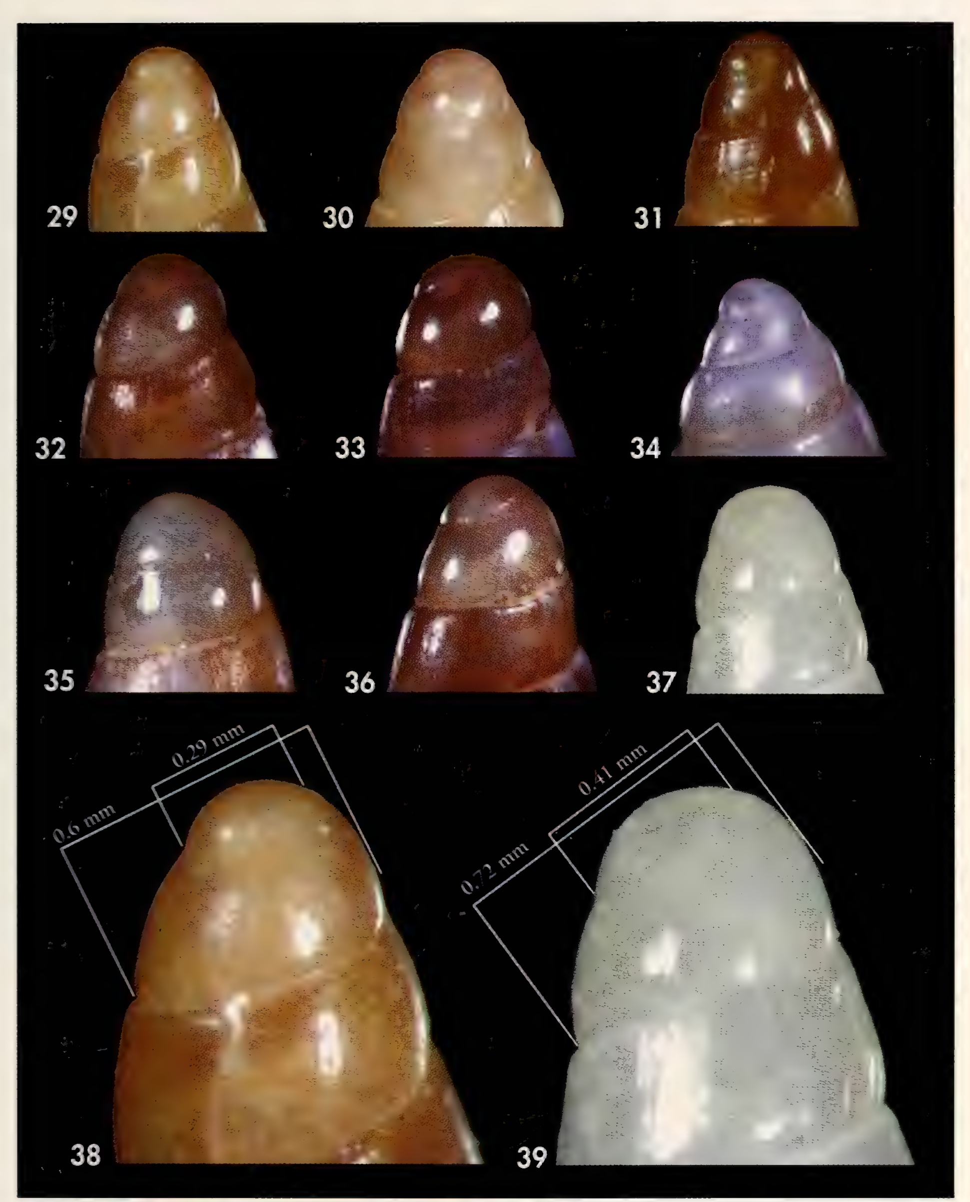
Description: The shell (Figs. 8-10) is solid, smooth, lanceolate with an elongate spire. The whitish protoconch (Fig. 11) is large, pupoid and smooth. No clear separation with the teleoconch occurs, but under magnification it appears to be made of one whorl reaching about 750 µm of diameter at the base and of a wide bulbous nucleus of about 500 µm. The spire has about 5 smooth flat whorls, an evident incised suture without subsutural step and its sides show a slightly concave outline. There are about eleven spiral striae occur at the base of the body whorl. The aperture is small, subtriangular, comma-shaped, and it is continued with a sinuous siphonal canal relatively long and narrow for the genus. The columella bears 5 scarcely evident teeth. The columellar callus is slightly extended externally, convex and moderately prominent. Seven well marked labial teeth occur inside the aperture and are prolonged internally as lirae. The outer lip has a wide external thickening.

The colour pattern is light honey brown with numerous small ovoid white dots all over the shell; a discontinuous suprasutural line is formed by dark brown spots alternating with lighter ones, a similar subsutural line is formed by longer, larger and more spaced out dark brown dashes.

The lattice-patterned periostracum (Figs. 40, 41) is very thin.

Dimensions: The holotype (Fig. 8) is 11.0 x 3.8 mm. Some shells reach up to 13 mm length.

Headfoot: Some specimens have been observed alive from Northwest Gran Canaria, dredged at 50 m. The headfoot shows a creamy-white background with brown-violet dashes and stains, the siphon showing also small yellow spots. The distal parts are white, like are the lateral sides of the foot and a line bordering the propodium and the opercu-



Figures 29-31, 38. *Mitrella minor*, protoconchs. 29: specimen from Marbella, 70-80 m (CJH); 30: specimen from Siracusa, 100 m, (CJH); 31: specimen from Gneja Bay, Malta (CCM); 38: same as Figure 29. Figuras 32-37, 39. *Mitrella hernandezi*, protoconchs. 32: specimen from Alboran Island, 20 m (CJH); 33: specimen from Alboran Island, 20 m, (CJH); 34: specimen from Alboran Island, 20 m (CJH); 35: specimen from NW Gran Canaria, 150 m (CJH); 36: specimen from NW Gran Canaria, 150 m (CJH); 37: specimen from Western Sahara, 60 m (CJH); 39: same as Figure 37.

Figuras 29-31, 38. Mitrella minor, *protoconchas. 29: ejemplar de Marbella, 70-80 m (CJH); 30: ejemplar de Siracusa, 100 m, (CJH); 31: ejemplar de Gneja Bay, Malta (CCM); 38: el mismo que la Figura 29. Figuras 32-37, 39.* Mitrella hernandezi, *protoconchas. 32: ejemplar de la isla de Alborán, 20 m (CJH); 33: ejemplar de la isla de Alborán, 20 m, (CJH); 34: ejemplar de la isla de Alborán, 20 m (CJH); 35: ejemplar del NO de Gran Canaria, 150 m (CJH); 36: ejemplar del NO de Gran Canaria, 150 m (CJH); 37: ejemplar de Sahara Occidental, 60 m (CJH); 39: el mismo que la Figura 37.*

lum area. A live animal is pictured in HERNÁNDEZ AND BOYER (2005).

The operculum (Fig. 14) is ovoid with a terminal nucleus and an insertion mark divided in two parts by a strong wrinkle.

Radula: Typical of the genus, with a rectangular rachidian tooth and two stretched marginal teeth bearing one bulbous cusp near to the base and two hooked cusps along the distal side (Fig. 15).

Distribution: From Alborán Island to Northern Senegal, live specimens from 20 to 300 m.

Remarks: The protoconch shows about 1.75 whorl, and the "nucleus width/base width ratio" is of about $^2/_3$ (Figs. 16, 17, 32, 33, 35-37, 39), except in the case of one specimen from Alborán Island (Fig. 34) which has a greyish pointed protoconch with a ratio closer to $^1/_2$. However, all the other shell features of this specimen reach the common features of *Mitrella hernandezi* sp. nov. and its protoconch is assumed to result from a teratologic event (low stepped apex differing noticeably from the pointed apex of *M. minor*). A depressed zone under the nucleus is sometimes evident in the protoconch of *M. hernandezi* (Figs. 32, 33), but it is often faint or lacking (Figs. 34-37). The striae at the base of the last whorl count 9 to 16, being more often 10-11. The columellar teeth count 5 to 7. For the other morphologic features of its shell, like for its colour pattern, *M. hernandezi* is very constant all along its wide range of distribution.

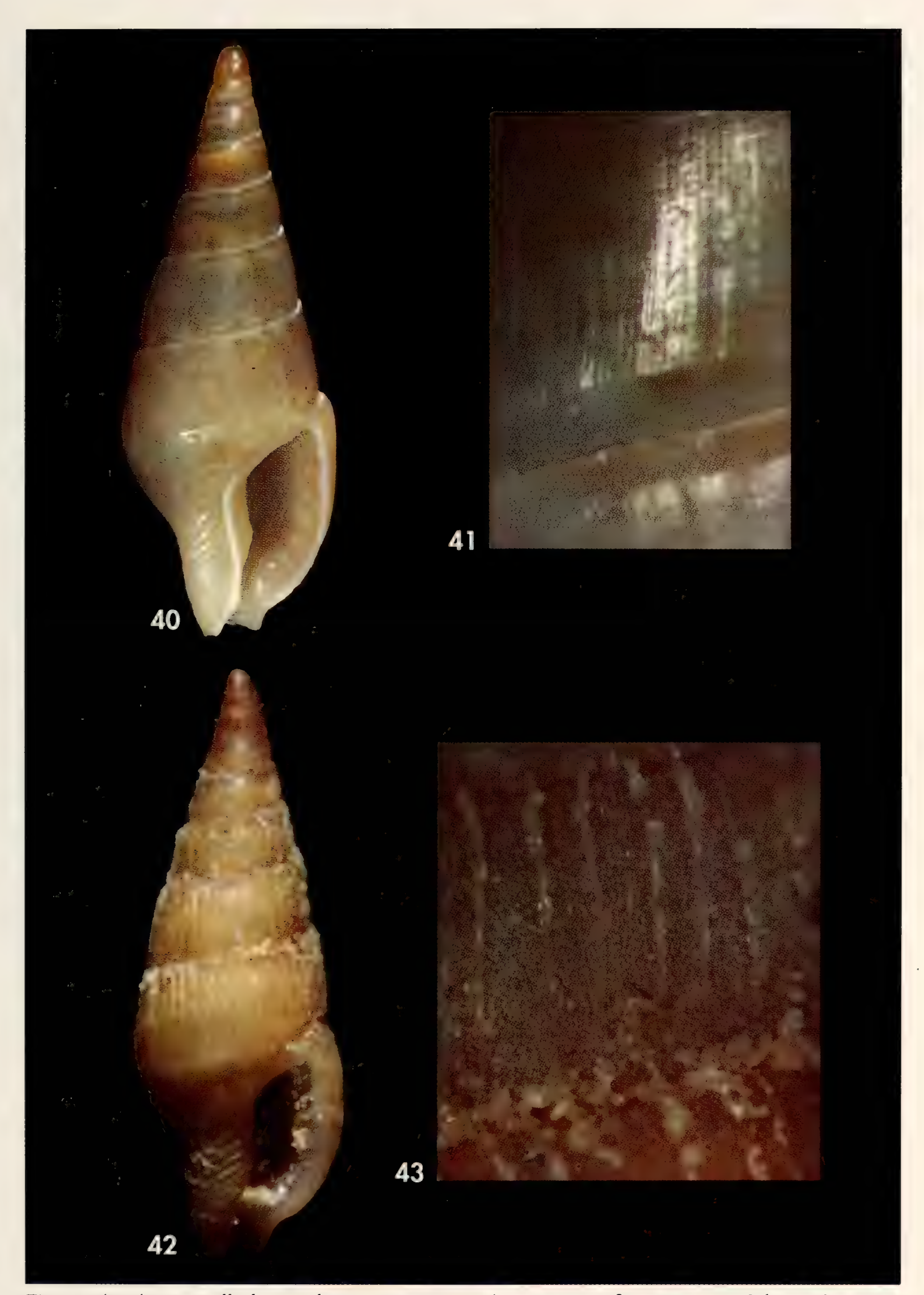
Some populations of *M. hernandezi* from Western Sahara show a very light and attenuated shell colour decoration. In any case they show the fine suprasutural and subsutural interrupted lines mentioned in the description. Few shells from Gran Canaria may show a pupoid light brown protoconch instead of whitish as usual (CFB).

NORDSIECK AND GARCIA-TALAVERA (1979) mentioned and illustrated our new species *M. hernandezi* as "*Mitrella svelta* (Monterosato) Kobelt, 1901" from the Canary Islands (La Palma) and from North Africa. In CHIARELLI, MICALI AND QUADRI (2003), *M. svelta* Kobelt, 1889 (ex Monterosato ms) is considered to be an error *pro M. spelta* (Kobelt, 1893), which is placed in synonymy with *Mitrella lanceolata* (Locard, 1886), a species very similar to the common Mediterranean *Mitrella scripta* (Linnaeus, 1758).

M. hernandezi must be considered as a sibling species of *M. minor* ("pseudo-sibling species" according to KNOWLTON, 1993), being distinguishable principally on the basis of its strong pupoid (generally white) protoconch with a "nuclear width/base width ratio" of about $^2/_3$ instead of a smaller pointed (generally brown) protoconch in *M. minor* with a ratio of about $^1/_2$, and on the basis of its very thin lattice-patterned periostracum instead of a thick coarsely wrinckled one in *M. minor*. The shell aperture in *M. hernandezi* is more triangular, often smaller and narrower than in *M. minor*, the siphonal canal is generally longer, the outer lip more angular and the labial denticles stronger. The incised suture and the concave outline of the spire sides seem also to be specific features of *M. hernandezi*, despite the occurrence of some intergrading cases in *M. minor*. The usual shell decoration of *M. hernandezi* is characterized by a pattern of small packed white dots, which has not a real equivalent in *M. minor* (Figs. 21, 22), who presents a much more variable shell decoration.

Albeit the average number of spiral striae at the base of the body whorl is 10-11 in *M. hernandezi* and 12-13 in *M. minor*, higher numbers of striae may occur in *M. hernandezi* and lower numbers may occur in *M. minor*. The colour design of the animal is similar in both species.

Despite the lack of data about the forms ranging off the western coasts of Morocco between Cape Spartel and Cape Juby, the record of specimens of *M. hernandezi* collected by J. M. Hernández himself off Alborán Island (CJH, 20 m) and the record from the same place of shells of *M. minor* (MNCN, 60-250 m) allow to state about the sympatry of both species at least off Alborán Island, and probably all along the western coasts of Morocco.



Figures 40, 41. *Mitrella hernandezi*, periostracum. 40: specimen from Western Sahara, 60 m, 10 mm (CJH); 41: same as Figure 40, detail. Figures 42, 43. *Mitrella minor*, periostracum. 42: specimen from Gneja Bay, Malta, 130 m, 9.7 mm (CCM); 43: same as Figure 42, detail.
Figuras 40, 41. Mitrella hernandezi, *periostraco. 40: ejemplar de Sahara Occidental, 60 m, 10 mm (CJH); 41: el mismo que la Figura 40, detalle. Figures 42, 43.* Mitrella minor, *periostraco. 42: ejemplar de Gneja Bay, Malta, 130 m, 9,7 mm (CCM); 43: el mismo que la Figura 42, detalle.*

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Notes on the columbellid fauna from the infralittoral and circalittoral levels of the Canary Islands

Notas sobre los columbelidos del infralitoral y circalitoral de Canarias

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ABSTRACT

The columbellid species found in the infralittoral and the circalittoral off the Canary Islands and attributed to the genera *Columbella, Mitrella, Anachis, Parvanachis, Zafra* and *Nassarina* are discussed. Taxonomy, phenetic variability and range of distribution of the species are commented.

Mitrella turbita (Duclos, 1840) is confirmed to be found off Gran Canaria, and it is recorded for the first time from Fuerteventura. *Nitidella ocellina* Nordsieck, 1975 and *Pusionella scripta* Nordsieck, 1975 are considered as junior synonyms of *Mitrella broderipi* (Sowerby, 1844). A slender "deeper form" of *Mitrella broderipi* is recorded from the Canary Islands and it is showed to belong to the morphologic variability of the species. The overall morphologic similarity with *Mitrella broderipi* and the presence of the same array of chromatic variation leads to make the hypothesis that *Anachis avaroides* Nordsieck, 1975 might be a ribbed variation of *M. broderipi.* The occurrence of *Mitrella bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984 is confirmed in the Canary Islands, with a stout shelled "shallow form", similar to the populations found in Mediterranean, and a slender "deeper form" restricted to the Canary Islands. *Buccinum canariense* d'Orbigny, 1839 is stated to be a junior synonym of *Mitrella ocellata* (Gmelin, 1791).

The Caribbean species *Parvanachis obesa* (C. B. Adams, 1845) is recorded from the harbour of Santa Cruz de Tenerife. This occurrence is interpreted as resulting from an accidental human introduction, but the maintaining of the discovered population remains to be confirmed. Conversely, the Indo Pacific species *Zafra exilis* (Philippi, 1849) is confirmed to occur all around Gran Canaria and possibly to be settling in Tenerife, as a case of successful introduction by the naval traffic. The documentation at hand leads to consider that failed introductions may be frequent, as resulting directly from the contemporary maritime economy. *Nassarina rietae* Segers and Swinnen, 2004 is considered as a possible endemic from the Canary Islands.

The presence of axial ribs is showed to be very variable within a species like *M. turbita* or within a species-group like the *M. broderipi / M. avaroides* one. As a result, the separation between the *Mitrella* group and the *Anachis* group on the basis of the lack or of the presence of axial ribs is appreciated as being artificial. This point is proposed as an argument for a reviewing of the supraspecific classification of the Columbellidae.

RESUMEN

Se discuten las especies de la familia Columbellidae presentes en el infralitoral y el circalitoral de Canarias, atribuidas a los géneros *Columbella, Mitrella, Anachis, Parvanachis,*

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Zafra y Nassarina, poniendo especial énfasis en su táxonomía, variabilidad fenética y distribución de las especies.
Se confirma la presencia de *Mitrella turbita* (Duclos, 1840) en Gran Canaria, y se cita por primera vez en Fuerteventura. Se considera *Nitidella ocellina* Nordsieck, 1975 and *Pusionella scripta* Nordsieck, 1975 como sinónimos posterior de *Mitrella broderipi* (Sowerby, 1844). Una forma alargada, de profundidad, de *Mitrella broderipi* se cita de Gran Canaria y se demuestra su pertenencia a la variabilidad morfológica de la especie. Asimismos, la semejanza de sus características morfológicas y la presencia en ambas del mismo rango de variaciones cromáticas nos hace pensar que *Anachis avaroides* Nordsieck, 1975 podría ser una variedad con costillas de *Mitrella broderipi*. Se confirma la presencia de *Mitrella bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984 en Canarias, con dos formas, una forma rechoncha, de aguas someras, similar a las poblaciones del Mediterráneo, y una forma esbelta, de aguas profundas, restringida a Canarias. Se considera *Buccinum canariense* d'Orbigny, 1839 como sinónimo posterior de *Mitrella ocellata* (Gmelin, 1791).
La especie del Caribe *Parvanachis obesa* (C.B.Adams, 1845) se cita en aguas someras de Santa Cruz de Tenerife. Esta presencia es interpretada como resultado de una introducción humana accidental, pero el mantenimiento de la población descubierta, queda pendiente de confirmar. Se confirma la presencia de la especie indo-pacífica *Zafra exilis* (Philippi, 1849) en toda Gran Canaria y su posible establecimiento en Tenerife, como un caso de introducción exitosa, debido a la actividad industrial. La documentación disponible, nos conduce a pensar que introducciones fallidas de especies son probablemente frecuentes, como resultado directo de la economía marítima contemporánea. Se considera *Nassarina rietae* Segers and Swinnen, 2004 como una posible especie endemica de las Canarias.
Se muestra que la presencia de costillas axiales es muy variable dentro de especies como *M. turbita* o en el complejo *M. broderipi / M. avaroides*. Como resultado, la separación entre el grupo *Mitrella* y *Anachis* en base a la ausencia o presencia de costillas axiales, parece ser artificial. Esto se propone como argumento para un replanteamiento de la clasificación supraespecífica de los Columbellidae.

KEY WORDS: *Columbellidae*, taxonomy, phenetic variability, distribution, deep forms, sibling species, introduced species, Canary Islands.
PALABRAS CLAVE: *Columbellidae*, taxonomía, variabilidad fenética, distribución, especies gemelas, especies introducidas, Islas Canarias.

INTRODUCTION

Whereas the Columbellidae from the Mediterranean have been the subject of recent works of revision (VAN AARTSEN, MENKHORST AND GITTENBERGER, 1984; LUQUE, 1986; CHIARELLI, MICALI AND QUADRI, 2003), so much attention has not be given to the species from Northeast Atlantic.

The illustrated catalogue of NORDSIECK AND GARCÍA-TALAVERA (1979) on the species from the Canary Islands is the only attempt to present a general view of a local columbellid fauna within this area, through the picturing and the comment of 14 morphospecies. The recent list of Columbellidae published by HERNÁNDEZ OTERO, GARCÍA-TALAVERA AND HERNÁNDEZ GARCÍA (2003) in the frame of the Biota project (Inventory of the Canarian marine fauna) gives 11 taxa, of whose only 6 are quoted by NORDSIECK AND GARCÍA-TALAVERA (1979). This simple fact shows how much controversial remains the taxonomy of the local columbellids.

The limited scope of this article is to summarize the present knowledge on the columbellid fauna from the infralittoral and upper circalittoral levels of the Canary Islands (about 0-100 m), with a special point on the taxonomy of species

and genera, on their phenetic variability and on their range of distribution. The genera *Amphissa* H. and A. Adams, 1853 and *Astyris* H. and A. Adams, 1853 are both recorded from the Canary Islands by NORDSIECK AND TALAVERA (1979) through 3 specific taxa which are considered by RADWIN (1978 b) as corresponding to 2 controversial amphiatlantic species from deep waters of Northern Atlantic. Due to their status of bathyal species, the study of these Canarian items are out of the scope of the present article.

Despite the opinion of RADWIN (1978 a) about the limited conception of the genus *Anachis* H. and A. Adams, 1853, implied by Tate´s selection of the type species *Columbella scalarina*, the use of this taxon is preferred here to the use of the more recent genus *Costoanachis* Sacco, 1890 which does not resolve the issue of the wide morphologic disparity at work in the complex of axially ribbed spindle-shaped columbellids. The other genera are used following the RADWIN's position (1977, 1978 a, 1978 b).

This study is based principally on the observations and on the collection of both authors, on the M. Bermejo collection deposited in Museo Canario (Las Palmas, Gran Canaria), and on the private collections of W. Engl and of F. Swinnen.

The term of "sibling species" is used in the trivial sense of "species sharing very similar features" (KNOWLTON, 1993).

Abbreviations:

sh: shells.
many sh: > 20 sh.
CVI: Cape Verde Islands.
Fu: Fuerteventura
GC: Gran Canaria;
Go: La Gomera
Hi: El Hierro
La: Lanzarote
Pa: La Palma
Ma: Madeira
Te: Tenerife
WS: Western Sahara
MNHN: Muséum National d'Histoire Naturelle, Paris.
SMF: Senckenberg Museum, Frankfurt.
FBC: F. Boyer Collection.
FSC: F. Swinnen Collection.
JHC: J. Hernandez Collection.
MBC: M. Bermejo Collection, Museo Canario, Las Palmas.
WEC: W. Engl Collection.

SYSTEMATIC PART

Family COLUMBELLIDAE Swainson, 1840
Genus *Columbella* Lamarck, 1799

Type species by monotypy: *Voluta mercatoria* Linnaeus, 1758.

Columbella adansoni Menke, 1853 (Fig. 1)

Material examined: Ma: 1 sh, 9-12 m, JHC. Hi: 1 sh, 5-12 m, JHC. GC: many sh, 0-90 m, JHC (Fig.1); many sh, 0-3 m, FBC. La: many sh, 0-3 m, FBC. Fu: 12 sh, 0-60 m, JHC.

Taxonomy: Attributed for a long time to the non-planktotrophic species *Columbella rustica* (Linnaeus, 1758) and more specially to the morph *C. striata* Duclos, 1835 (for instance in NORDSIECK AND GARCÍA-TALAVERA, 1979), the *Columbella* species distributed in the Canary Islands has been recently demonstrated to belong to the planktotrophic sibling species *C. adansoni* Menke, 1853, described from the Cape Verde Islands (MOOLENBEEK AND HOENSELAAR, 1991). *C. adansoni* was pictured in NORDSIECK AND GARCÍA-TALAVERA (1979) as "*C. rustica striata* Duclos, 1835" and also as "*Columbella spec.*" for a tall-spired form (subadult shell).

The belonging of *C. adansoni* to the genus *Columbella* is not suspicious, as its shell morphology is very close to that of

the type species *C. mercatoria* (Linnaeus, 1758).

Distribution: *C. adansoni* was said to be restricted to the Macaronesian Islands by MOOLENBEEK AND HOENSELAAR (1991), whereas *C. rustica* was said to be restricted from Mediterranean to Senegal. OLIVERIO (1995) enlarged the distribution of *C. adansoni* to the remainder of the West African Province, this distribution being confirmed from Sierra Leone to Central Angola by ROLÁN AND RYALL (1999).

The distribution of *C. adansoni* in Canary Islands is general, from low tide level to 90 m. The species is especially abundant under boulders in shallow water.

Remarks: The complex *C. rustica* / *C. adansoni* has been cited (for instance in THORSON, 1949) as a classic example of poecilogony (intraspecific variation in the mode of larval development) in molluscan gastropods.

MOOLENBEEK AND HOENSELAAR (1991) stated the presence, in the Macaronesian *C. adansoni*, of a multispiral protoconch indicating a planktotrophic development and, in the Mediterranean and North West African *C. rustica*, of a paucispiral protoconch indicating a "direct development" (more exactly it is intracapsular metamorphosis).

The electrophoresis analysis performed by OLIVERIO (1995) confirmed the separation of both species at the genetic level, the initial divergence being estimated from about 2 millions years. OLIVERIO (1995) emphasizes that "this time can be correlated to the onset of glaciations, and especially with their extension to southern regions". This could explain the present distribution of *C. rustica*, which may have reached its full intracapsular development during a glacial isolation stage within Mediterranean, before to extend to the North West African coasts, while *C. adansoni* remained protected from the cold Canary current in the offshore Macaronesia Islands.

It must be noted that the sibling species *C. rustica* and *C. adansoni* are presently separated only on the basis of their respective protoconch and of their genetic distance, but they remain to be fully studied in other ways, specially concerning the variability of the shell morphology, the external features and the anatomy of the soft parts, the ontologic development at the juvenile stage and the general behaviour at the adult stage.

A superficial examination of the animals of *C. adansoni* in Canary Islands (milky white to creamy white ground, with zones flecked of deep white dots, large golden brown to amber patches, small rounded yellowish operculum with black axis, scalloped by a deep yellow-orange line in its anterior part and by a black line in its posterior part) did not allow to recognize any significant difference with regard to the animals of *C. rustica* examined by the authors from Mediterranean and from Senegal.

Genus *Mitrella* Risso, 1826

Type species by subsequent designation (Cox, 1927:28): *Mitrella flaminea* Risso, 1826 [= *Mitrella scripta* (Linnaeus, 1758)].

Mitrella cf. *minor* (Scacchi, 1836) (Figs. 3, 57)

Columbella minor Scacchi 1836

Material examined: Siracusa: 2 sh, 100 m, JHC. Malaga: 12 sh, 80 m, JHC. Marbella: 3 sh, 30-40 m, FBC. Algeciras: 3sh, 18-22 m, FBC. Ma: 1 sh, 80 m, FSC. Pa: 4 sh, 80 m, WEC; 4 sh, 60-100 m, FSC. GC: many sh, 12-520 m, JHC (Figs. 3, 57); 10 sh, 34-200 m, FBC. La: 1 sh, FSC. WS: many sh, 30-83 m, JHC; 12 sh, 30-60 m, FBC.

Taxonomy: In the recent literature, the attribution of *Columbella minor* Scacchi, 1836 to the genus *Mitrella* Risso, 1826 is generally preferred to the use of the

genus *Columbellopsis* Bucquoy and Dautzenberg, 1882, specially created for giving a distinct status to *C. minor*. In fact, *C. minor* presents original morphologic features in the anterior part of its shell, with a narrow and sinuous siphonal canal, a small triangular aperture and a very concave left side of the base. These features are clearly divergent from the ones found in the other *Mitrella* species ranging in the Lusitanian Province, especially from the Mediterranean *M. scripta* (Linnaeus, 1758), type species of *Mitrella*. The genus *Mitrella* being applied to a vast array of shell morphologies and being still waiting for a general revision, it seems that the conservative way is more appropriate in the present case and we propose to keep the generic taxon *Mitrella* for the placement of *Columbella minor*.

LUQUE (1986) reports some differences between the shells from Canary Islands attributed to "*Mitrella minor*" and those from Mediterranean, western Iberian Peninsula and northwest Morocco. The shells from Canary Islands are said to show a somewhat different colour pattern and a lower number of spiral striae at the base of the last whorl. On this ground, LUQUE remains reserved on the specific attribution of the Canarian population, which is described as a new taxon in a companion paper by BOYER AND ROLÁN (2005). *M.* cf. *minor* from the Canary Islands is reported and pictured as "*Mitrella svelta* (Mtrs) Kobelt 1901" in NORDSIECK AND GARCÍA-TALAVERA (1979). *M. svelta* is a misspelling for *M. spelta* (Kobelt, 1893), considered to be a dubious species by VAN AARTSEN *ET AL.* (1984), possibly matching the shallow Mediterranean morph *M. lanceolata* (Locard, 1886) belonging to the *M. scripta* complex.

Distribution: *Mitrella minor* sensu lato is distributed in Mediterranean and from Vigo to northern Senegal. It is widely distributed in Canary Islands from 30 to about 500 m, apparently on soft and detritic bottoms.

Remarks: The animals observed from the Canary Islands are mottled of brown and flecked of deep white dots on a whitish ground (Fig. 57). This colour pattern is very similar to the one observed in specimens from Algeciras. The oval operculum is light yellowish.

Mitrella pallaryi (Dautzenberg, 1927) (Figs. 2, 58)

Pyrene pallaryi Dautzenberg, 1927

Material examined: Marbella: 4 sh, 70-80 m, FBC. Alboran Island: 1 sh, 20 m, JHC. Pa: 15 sh, 150-250 m, FBC. Go: 1 sh, JHC. Te: 2 sh, 60-100 m, JHC. GC: many sh, 60-520 m, JHC (Figs. 2, 58). La: 1 sh, 46-50 m, WEC. WS: 1 sh, 58 m, JHC.

Taxonomy: *Pyrene pallaryi* Dautzenberg, 1927 is placed in *Mitrella* by all the recent authors. The use of the taxon *Pyrene* is certainly unappropriate in the present case, as the type species *Pyrene punctata* (Bruguière, 1789) has an ovate outline, a somewhat turbinate top, a narrow accent-shaped aperture and very strong basal cords.

P. pallaryi shares most of the classic shell features of *Mitrella* except for its large size and for its turriculated spire. However, we propose to keep the species in *Mitrella*, following the last reviewers (LUQUE, 1986; ROLÁN AND TRIGO, 2000) and in the wait of a general re-assessment of this group.

M. pallaryi is pictured under its right specific name by NORDSIECK AND GARCÍA-TALAVERA (1979), but associated to the unusual subgenus *Paratilia*.

Distribution: The species is known to range in circalittoral and upper bathyal from Galicia and Mediterranean to northern Angola, comprising the Açores, Madeira and the Canary Islands, but it may be a discontinuous distribution, records being lacking south

from Senegal to Congo (ROLÁN AND TRIGO, 2000).

The species is widely distributed in Canary Islands from 50 to about 500 m, apparently on soft and detritic bottoms.

Remarks: The animals observed from the Canary Islands are whitish, mottled of reddish brown spots and patches (Fig. 58). The sole is clearer. The operculum is subtranslucent, faintly square, with a brownish violet patch, "Y" shaped at its center.

LUQUE (1986) and ROLÁN AND TRIGO (2000) gave details about the shell, the protoconch, the operculum and the radula in populations from continental Spain and from Angola. The multispiral protoconch has 3 to 3.5 smooth whorls, and the species is considered to have a planktotrophic development (ROLÁN AND TRIGO, 2000). As expected in such a case, *M. pallaryi* looks as being very constant in its whole range of distribution.

Mitrella turbita (Duclos, 1840) (Figs. 4-6)

Columbella (Seminella) rac Dautzenberg, 1891

Material examined: GC: 2 sh, 10-15 m, WEC (Figs. 4-6). Fu: 3 sh, 0 m, MBC.

Taxonomy: *Mitrella rac* (Dautzenberg, 1891) was named from a material collected in Dakar, Senegal, after a non-binomial name given by Adanson. The species named by DAUTZENBERG (1891) is accurately described and pictured, and it corresponds to one of the most abundant and distinctive species of *Mitrella* found about the Peninsula of Cap Vert. However PELORCE AND BOYER (2005) have shown that the name *Mitrella turbita* (Duclos, 1840) has precedence and must be used as the valid name for this taxon.

The few shells found in Canary Islands (Figs. 4-6) match perfectly the material studied from Dakar. It must be noted that most of the shells wear strong sinuous axial ribs at the center of the last whorl and strong spiral cords at the base of the last whorl. As such, *M. turbita* might be interpreted as an intergrade between the genera *Mitrella* and *Anachis*. *M. turbita* is not recorded neither pictured by NORDSIECK AND GARCÍA-TALAVERA (1979).

Distribution: The species is well-known from the Peninsula of Cap Vert (Senegal), as restricted to different kinds of hard bottoms from 0 to 40 m. It was observed in Cape Blanco (northern Mauritania) by E. Rolán (pers. comm.), and it was recorded from Gran Canaria through one sampling in ALONSO AND JIMÉNEZ MILLÁN (1979). Its presence in Gran Canaria and in Fuerteventura is confirmed here by 2 new findings. This thermophilic species is probably restricted to the tepid shallow water ranging off these two islands and it

(Right page) Figure 1. *Columbella adansoni*, 16 mm, 12 m, Sardina, Gran Canaria, JHC. Figure 2. *Mitrella pallaryi*, 15 mm, 232 m, off Tasarte, Gran Canaria, JHC. Figure 3. *Mitrella* cf. *minor*, 11 mm, 150 m, off North West Gran Canaria, JHC. Figures 4-6. *Mitrella turbita*. 4, 5: 8.4 mm, 10-15 m, Gran Canaria, WEC; 6: 9.1 mm, 10-15 m, Gran Canaria, WEC. Figures 7-9. *Mitrella bruggeni*. 7: 12 mm, low tide, Orzola, Lanzarote, WEC; 8, 9: 9 mm, 1 m, Isla de Lobos, Fuerteventura, JHC.
(Página derecha) Figura 1. Columbella adansoni, *16 mm, 12 m, Sardina, Gran Canaria, JHC. Figura 2.* Mitrella pallaryi, *15 mm, 232 m, off Tasarte, Gran Canaria, JHC. Figura 3.* Mitrella *cf.* minor, *11 mm, 150 m, off North West Gran Canaria, JHC. Figuras 4-6.* Mitrella turbita. *4, 5: 8.4 mm, 10-15 m, Gran Canaria, WEC; 6: 9.1 mm, 10-15 m, Gran Canaria, WEC. Figuras 7-9.* Mitrella bruggeni. *7: 12 mm, marea baja, Orzola, Lanzarote, WEC; 8, 9: 9 mm, 1 m, Isla de Lobos, Fuerteventura, JHC.*


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seems to reach there the northern limit of its distribution.

Despite the fact that *M. turbita* has not been recorded from Western Sahara until now, it must be noted that this area remains very poorly sampled as far as hard bottoms are concerned, and there is no concrete reasons, in the present state, to believe that the scarce populations of *M. turbita* in the Canary Islands are only relics of an older expansion of the species during a past warmer period, or even resulting from an accidental introduction coming from the human industry.

Remarks: Only dead shells have been collected in Canary Islands, so the animal in these populations was not compared with the animals from Senegal documented by the authors. However the few shells studied from Canary Islands match perfectly the most common shell morphology and colour pattern found in *M. turbita* off the Peninsula of Cap Vert.

Mitrella broderipi (Sowerby, 1844) (Figs. 10-18, 28-30, 40, 59)

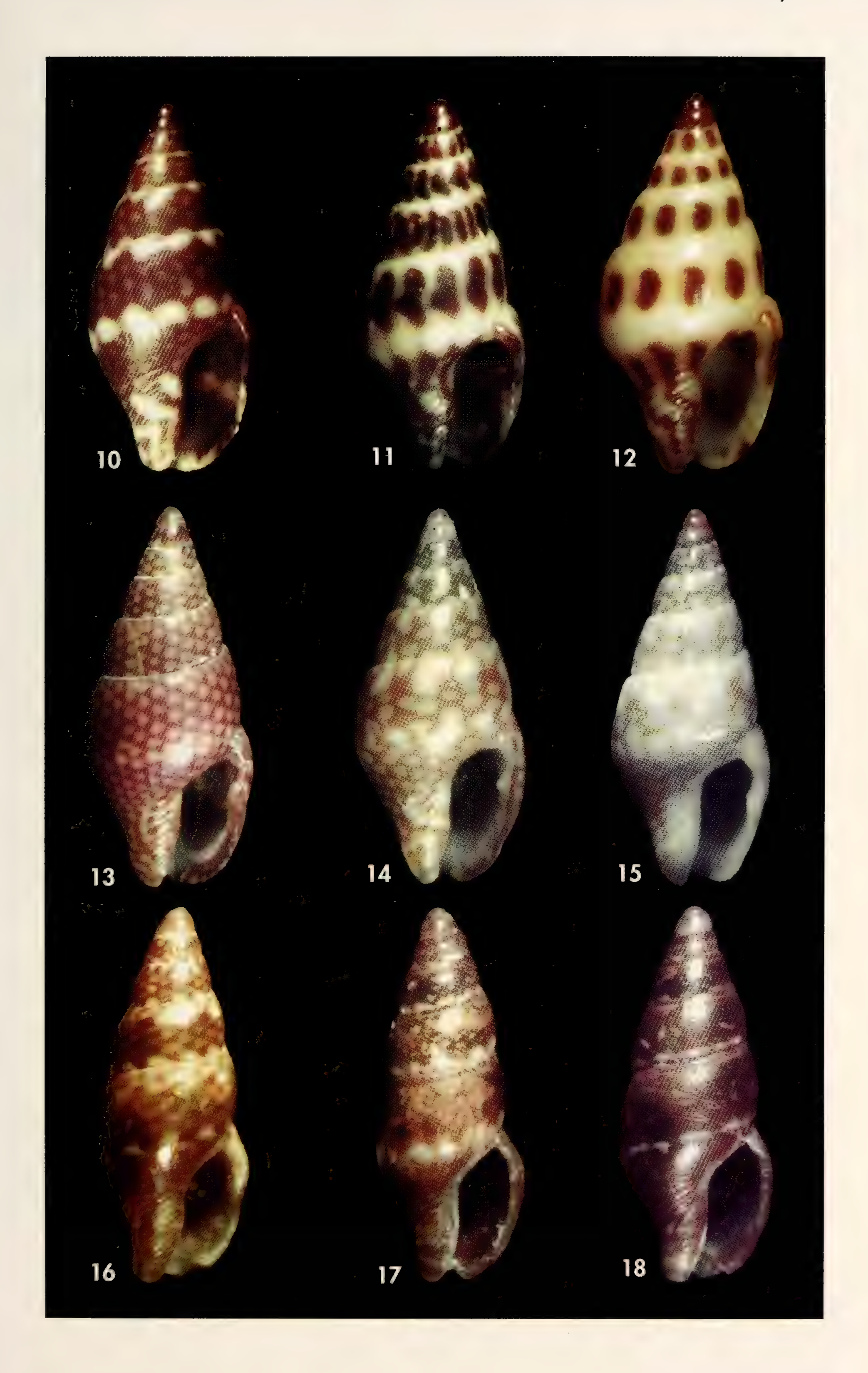
Columbella broderipi Sowerby, 1844

Material examined: "Shallow form": Málaga: 8 sh, 10 m, JHC. Estepona: 4 sh, 1-2 m, FBC. Algeciras: many sh, 1-3 m, FBC. Cádiz: 5 sh, 0 m, JHC. Ceuta: 3 sh, 0 m, JHC. Alborán Island: 18 sh, 20 m, JHC. Ma: 7 sh, 15-30 m, FSC. Selvagen Grande: many sh, FSC. Pa: 2 sh, FSC. GC: many sh, 0-135 m, JHC (Figs 12, 29, 30, 59); many sh, 0-3 m, FBC (Figs. 10, 11, 13, 14); many sh, 0-15 m, FSC; many sh, MBC. La: 19 sh, 0-2 m, JHC; many sh, 1-3 m, FBC; many sh, MBC; many sh, FSC. Fu: many sh, 0-2 m, JHC; 1 sh, 0 m, FBC (Fig. 15); many sh, MBC.
"Deep form": Hi: many sh, 30-60 m, WEC (Figs. 16-18, 28). Go: many sh, 12 m, WEC. GC: 1 sh, 90-96 m, JHC (Fig. 40). La: 9 sh, 46-80 m, WEC; many sh, 30-50 m, FSC.

Taxonomy: *M. broderipi* (Sowerby, 1844) was revised by VAN AARTSEN *ET AL.* (1984) and by LUQUE (1986), with a distribution limited to the Alboran Sea, the Ibero-Moroccan Gulf and one finding at a great depth in Açores (DAUTZENBERG, 1927: 87). This last record is dubious and seems better to be a misidentification of *Astyris profundi* (Dall, 1889) from the lower circalittoral and the bathyal of Northern Atlantic (ABBOTT, 1974). The phena *M. broderipi* is in fact common in the Canary Islands, but known under the junior name of *Nitidella ocellina* Nordsieck, 1975, generally placed in *Mitrella*. In the same time than *M. ocellina*, was also described *Pusionella scripta* Nordsieck, 1975, which belongs with evidence to the range of variability of the same species. NORDSIECK AND GARCÍA-TALAVERA (1979) did not use longer the taxon "*P. scripta*", and they pictured 3 shells of *M. broderipi* under the name of "*N. ocellina*". Both taxa *N. ocellina* Nordsieck, 1975 and *P. scripta* Nordsieck, 1975 are proposed here as junior synonyms of *M. broderipi*.

Distribution: The species is confirmed to range on hard bottoms from the Alboran Sea and the Ibero-Moroccan

(Right page) Figures 10-18. *Mitrella broderipi*. 10: 6.4 mm,1-2 m, Arinaga, Gran Canaria, FBC; 11: 6.2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 12: 7 mm, 12 m, Gando, Gran Canaria, JHC; 13: 6,2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 14: 6 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 15: 6.9 mm, low tide, Granillo, Fuerteventura, FBC; 16: 5 mm, 30-55 m, Hierro, WEC; 17: 5.2 mm, 30-55 m, Hierro, WEC; 18: 5.1 mm, 30-55 m, Hierro, WEC.
(Página derecha) Figuras 10-18. Mitrella broderipi. *10: 6.4 mm,1-2 m, Arinaga, Gran Canaria, FBC; 11: 6.2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 12: 7 mm, 12 m, Gando, Gran Canaria, JHC; 13: 6,2 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 14: 6 mm, 1-2 m, Arinaga, Gran Canaria, FBC; 15: 6.9 mm, marea baja, Granillo, Fuerteventura, FBC; 16: 5 mm, 30-55 m, Hierro, WEC; 17: 5.2 mm, 30-55 m, Hierro, WEC; 18: 5.1 mm, 30-55 m, Hierro, WEC.*


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Gulf to Madeira and the Canary Islands. In this last place, shallow water populations (0-15 m) and deeper water populations (12-60 m) show distinct shell morphologies.

Remarks: The populations from shallow water inhabiting the Alboran Sea and the Canary Islands have been compared in live conditions by the authors: they perfectly match in all features of the shells, of the soft parts and of the operculum. They show the same range of variability for the shell morphology and colour pattern, and for the chromatism of the soft parts. The animals from the Canary Islands are brownish to jet black (with blue shades in this case) with whitish tips. Limited zones are flecked of deep white dots (Fig. 59). The sole is whitish to jet black. The operculum is subtranslucent, faintly square or more tear-shaped, with a dark patch at its center.

The populations from the Canary Islands ranging in deeper water (Figs. 16-18, 28) show generally a smaller, lighter and more slender shell with a dull chromatism, a higher spire with more convex whorls and a thinner labrum than in shallow water populations (Figs. 10-15, 29, 30). However, some intergrades can be found (Fig. 40), mostly from mid-infralittoral level (shallow form, deep form, and intergrades are found in the lot from La Gomera, WEC, collected in 12 m), with similar protoconch and shell morphology. As a matter of fact, the shell material found in shallow water (0-3 m) and the one from deeper water (30-60 m) present a real unity. The animals from deeper water were not examined and the chromatism of their soft parts remains unknown.

It must be noted that the shell material collected under 10 m. in Alboran Island (10-20 m) and in Madeira (15-30 m) does not differ from the "shallow form" found everywhere, whereas the shell material from the Canary Islands found under 10 m represents mostly the "deeper form" (12 m in La Gomera) or is exclusively composed by it (30-60 m in Hierro and Lanzarote).

On the ground of the elements at hand, there is no reason to state on a distinct taxonomic status of the "deeper form" of *M. broderipi* from the Canary Islands, and the transformation of the shell morphology with the depth can be interpreted as a phenetic adaptation to different abiotic constraints (or a simple variation randomly selected), genetically fixed but submitted to casual reproductive mixing with "shallow water" populations. This point deals with the important question of the drift of the genetic pool in such condition and of the degree of genetic exchanges between shallow and deeper populations. That refers to the topic of the "deep forms" status in marine gastropods, which waits for further investigations.

Mitrella bruggeni van Aartsen, Menkhorst and Gittenberger, 1984 (Figs. 7-9, 37-39, 41-45, 55, 56)

Material examined: "Shallow form": Malaga: 5 sh, 10 m, JHC. Algeciras: 2 sh, 1-3 m, JHC (Fig. 55); 16 sh, 1-3 m, FBC. Cadiz: 5 sh, 0 m, JHC. Ceuta: 1 sh, 0 m, JHC. Alboran Island: 5 sh, 20 m, JHC. Ma: many sh, FSC. Selvagen Grande: 1 sh, 0 m, MNHN. Te: 2 sh, 1-2 m, FSC; 3 sh, 0 m, MNHN. GC: 3 sh, 0-2 m, JHC; 1 fragment, 0 m, FBC. La: 19 sh, 0-2 m, FBC; 3 sh, 0-2 m, WEC; many sh, FSC. Fu: 8 sh, 0-2 m, JHC (Figs. 8, 9). 1 sh, MBC (Fig. 7).
"Deep form": Hi: 27 sh, 30-55 m, WEC (Figs. 37-39); GC: 5 sh, 15-90 m, JHC (Figs. 43-45, 56) La: 8 sh, 8-30 m, FBC; 15 sh, 46-50 m, WEC (Figs. 41, 42); 5sh, FSC. Fu: 1 sh, 0 m, JHC; 1 sh, BMC.

Taxonomy: Despite the statement of LUQUE (1986), *Mitrella bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984 has priority over the name *M. maldonadoi* Luque, 1984, issued in an abstract (LUQUE, 1984) which does not match the requirements of the Code of Nomenclature.

The shallow form of the species is easily distinguished from its relatives in Alboran Sea as well as in the Canary Islands, due to its ventricose body whorl, its regularly arched outer lip with subequal labial denticles extended on the inner wall, its slender pyramidal spire, and its bulbous stepped protoconch (Figs. 55-58). *M. bruggeni* differs from *M. turbita* by its stepped unicoloured browny to whitish protoconch instead of domed whitish protoconch with a light purple tip, the 6 whorls of its teleoconch instead of 5, its wide oval aperture instead or longer, narrower, rather rectangular and slightly comma-shaped, its 4 to 6 plaits on a very convex columellar callus instead of 2 to 4 plaits on a poorly convex callus, its subequal labial teeth instead of a much stronger tooth just below a small upper one, its poorly marked spiral cords at the base of the shell instead of strongly marked, and its less incised siphonal canal. Even if most of the shells of *M. turbita* show sinuous axial ribs at the mid-part of the last whorl, some specimens do not hold and they are similar to *M. bruggeni* from this point of view. Very few shells of *M. bruggeni* from Canary Islands and some more from Mediterranean present a colour pattern of white ocelles and axial stripes on a reddish-brown ground comparable to the common "reticulated pattern" found in *M. turbita*.

M. bruggeni might be a possible junior synonym of *M. coccinea* (Philippi, 1836). The topic was tackled but not resolved by PALMERI (1987) and CHIARELLI, MICALI AND QUADRI (2003), and it is under study by the second author.

M. bruggeni is pictured by NORDSIECK AND GARCÍA-TALAVERA (1979) under the names of "*Mitrella decollata* (Brusina, 1865)" and of "*M. hidalgoi* Monterosato, 1889".

Distribution: The species ranges on hard bottoms in shallow water (0-3 m) from the Alboran Sea to the Ibero-Moroccan Gulf and from Madeira to the Canary Islands. In this last place, populations from deeper levels (8-90 m) present a smaller, lighter, and more slender shell.

Remarks: The populations from shallow water inhabiting the Alboran Sea and the Canary Islands (Figs. 7-9, 55, 56) have been compared in live conditions: they perfectly match together in all features of the shells, on the soft parts and of the operculum, and they show the same range of variability for the morphology and for the colour pattern of the shells as well as for the chromatism of the soft parts. The animal is light yellowish to light beige with sparse light brown patches on the foot and on the siphon. The sole is light yellowish. The head and tentacles are whitish. The forehead and the sides of the head have longitudinal light brown marks; the axis of the tentacles is light brown. The sole, the siphon and the tentacles are flecked of deep white dots. The oval operculum is light yellow amber.

The populations from the Canary Islands ranging in deeper water (Figs. 37-39, 41-45, 57, 58) have a small lanceolate and subtranslucent shell, showing a higher spire with more convex whorls and a thinner labrum than in shallow water populations. The deeper water form seems to have been confused until now by collectors with the sympatric *M. broderipi* (Fig. 40). However, some intergrades between the shallow and the deeper water forms of *M. bruggeni* can be found (Fig. 41), mostly from the middle levels (as most of the 8 shells from southeast Lanzarote, 8-30 m, FBC), and the general morphology of the shells and of the protoconchs are similar. The animals from deeper water were not examined and the chromatism of their soft parts remains unknown.

It must be noted that the shell material collected below 10 m in Alboran Island (10-20 m) does not differ from the "shallow form" (0-3 m) found everywhere, whereas the shell material from the Canary Islands found below 8 m (8-90 m) represents only the deeper form or intergrading morphs (found in 8-30 m as well as in 46-50 m). Few shells of the "deeper form" can be collected as beached material in Fuerteventura, together with shells of the "shallow form", without evident intergrades.

These elements do not allow to infer that two sibling species are represented here. From a general point of view, the situation is similar to the one found in *M. broderipi*, with a shallow form and a deeper form which seem to range according to a bathymetric cline, and to present a somewhat homogeneous morphology at the population level. The casual finding of shells of the "deeper form" at the shore level may come from accidental transports of live larvae or dead shells due to local hydrodynamic conditions, or to rejects of artisanal fisheries.

Mitrella ocellata (Gmelin, 1791) (Figs. 46-48)

Voluta ocellata Gmelin, 1791

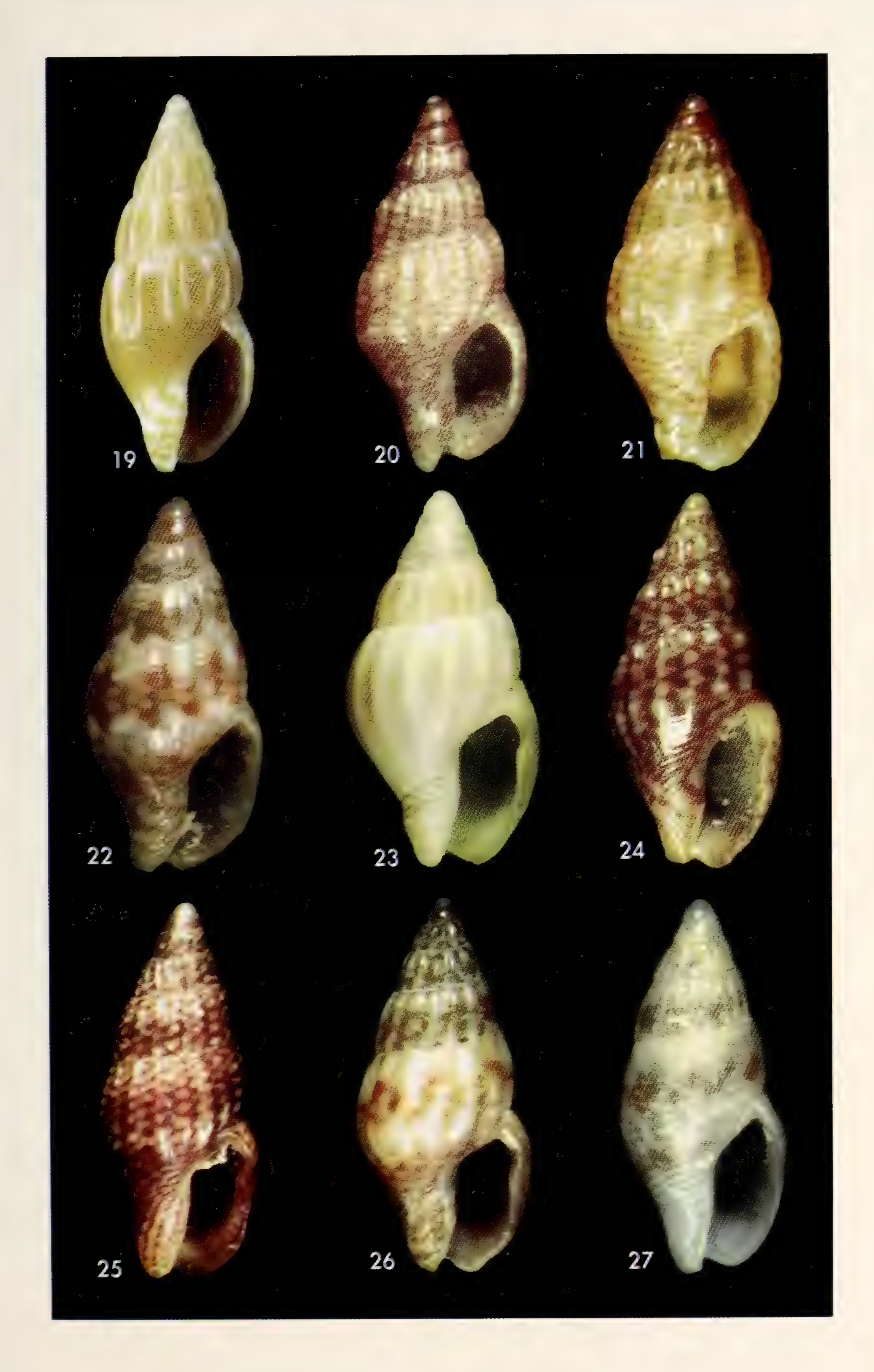
Material examined: Ma: 4 sh, 0-17 m, FSC. Te: many sh, 0 m, FBC (Fig. 46). GC: many sh, 0-8 m, JHC; 8 sh, 0-1 m, FBC (Fig. 47). La: 3 sh, 0 m, FBC (Fig. 48). Fu: many sh, 0 m, MBC.

Taxonomy: Depending on the authors, *M. ocellata* (Gmelin, 1791) is accepted as an amphiatlantic species or as a pantropical one, but the matter is still awaiting for further demonstration. The *M. ocellata* complex is discussed by Radwin (1978 b), who cites several sibling forms described from various places in the Indo-Pacific and Panamic Provinces. At least one of these sibling forms, ranging in the Galapagos Archipelago, can be separated at the specific level on the ground of the characters of its lateral radular tooth. One of the original features of the shells, besides their original subrectangular aperture with strong labial denticles and their ocellated colour pattern, is the usual lack of the apex in the adult stage.

M. ocellata was described without original locality. Radwin (1978 b) gave the Bahama Islands as subsequent type locality of the species. The sibling morph *M. cribaria* (Lamarck, 1822), frequently used in the literature for the populations ranging in Eastern Atlantic, was described from the Java Seas. The name *M. canariensis* (d'Orbigny, 1839), based on a shell from Tenerife belonging to the same complex *M. ocellata*, has not been used in the literature for the West African populations and rarely for the Canarian populations. The shell pictured in d'Orbigny (1839, pl. 6, figs. 35-37) as *Buccinum canariense* shows a morphology similar to that of *M. ocellata*, as far as the slender oval outline of the body whorl, the long pointed spire with flat to concave sides, the very acute apex, and the long narrow aperture are concerned. The dull shell decoration matches the ocellated pattern found in *M. ocellata*, as well as the alternate subequal white and dark subsutural square marks, and the dark spiral bands at the mid-part of the body whorl on a light chestnut brown ground. Despite the presence of the apex in the shell pictured in d'Orbigny (1839), which is generally removed in adult shells of *M. ocellata*, and despite the fact that the type material of

(Right page) Figures 19-27. *Anachis avaroides*. 19: SMF syntype (as "holotype"), 7 mm, Gran Canaria, SMF; 20: 4.6 mm, Sao Miguel, Açores, WEC; 21: 4.9 mm, 20 m, Funchal, Madeira, WEC; 22: 5 mm, 20 m, La Palma, WEC; 23: 5.4 mm, 20-30 m, San Sebastián, La Gomera, WEC; 24: 6 mm, 30-55 m, El Hierro, WEC; 25: 5.9 mm, 30-55 m, El Hierro, WEC; 26: 5.8 mm, 30-55 m, El Hierro, WEC; 27: 5 mm, 30-55 m, El Hierro, WEC.

(Página derecha) Figuras 19-27. Anachis avaroides. *19: syntype SMF (como "holotipo"), 7 mm, Gran Canaria, SMF; 20: 4.6 mm, Sao Miguel, Açores, WEC; 21: 4.9 mm, 20 m, Funchal, Madeira, WEC; 22: 5 mm, 20 m, La Palma, WEC; 23: 5.4 mm, 20-30 m, San Sebastián, La Gomera, WEC; 24: 6 mm, 30-55 m, El Hierro, WEC; 25: 5.9 mm, 30-55 m, El Hierro, WEC; 26: 5.8 mm, 30-55 m, El Hierro, WEC; 27: 5 mm, 30-55 m, El Hierro, WEC.*


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B. canariense was not examined, there is no serious reasons to doubt about the identity of this taxon, considered here as junior synonym of *M. ocellata*. It must be noted that some adult shells of *M. ocellata* from Tenerife (G. Hervillard Collection) and from Dakar (FBC) were observed to have kept their apex. The fact that the type material of *B. canariense* was found "in roots of gorgonas, fished off the harbour of Orotava" (D'ORBIGNY, 1839) does not signify necessarily the occurrence of a deep water species. The very steep slopes encountered along the coasts of Tenerife cause currently the fall of live mollusca or of shells from shallow water to deeper levels.

NORDSIECK AND GARCÍA-TALAVERA (1979) pictured as "*Nitidella ocellata* (Gmelin, 1889)" a shell matching the common form of *M. ocellata* found in Canary Islands (Figs. 46-48), itself perfectly similar, as far as the shell morphology and colour pattern are concerned, to the populations ranging in Cape Verde Islands, Senegal and Caribbean. On the same plate, NORDSIECK AND GARCÍA-TALAVERA (1979) pictured as "*Nitidella canariensis* (d'Orbigny, 1839)" a reddish shell with an intact apex and with dark spiral bands under the suture and at the mid-part of the last whorl. Even if uncommon, this form must be accepted within the natural variability of *M. ocellata*.

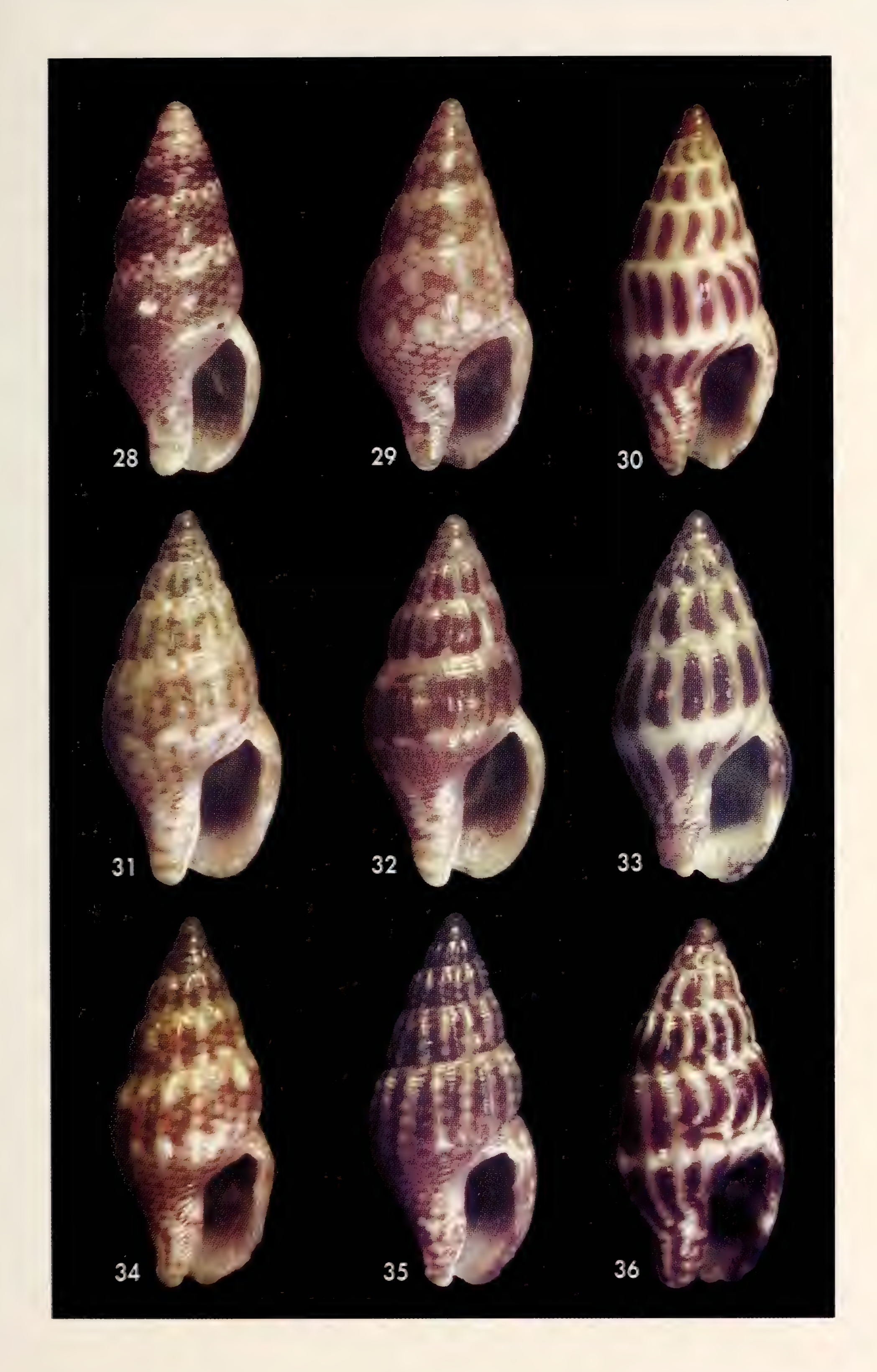
We propose to use provisionally the name *M. ocellata* for the whole Eastern Atlantic populations, thus accepting the possible occurrence of a united amphiatlantic species, and we propose to consider provisionally *B. canariense* d'Orbigny, 1839 as junior synonym of *M. ocellata*. However, the hypothesis of a sibling species in Eastern Atlantic waters, genetically and/or reproductively distinct from the Caribbean population, constitutes a possible alternative, due to the presence of a rather short protoconch (1.5 to 2.0 whorls with a coiled bulging top) supposed to be non-planktotrophic, that means having an intracapsular metamorphosis or a very short free-swimming larval stage (lecitotrophic non-feeding mode). Such a protoconch leads normally to a limited ability of dispersion, to a strong capacity of reproductive isolation and to the formation of distinct species at local or at regional scale. That is clearly the case in most of the *Mitrella* species known to us, which present both a short paucispiral protoconch and a limited distribution.

Distribution: The Eastern Atlantic populations of *M. ocellata* range on hard bottoms in very shallow water (intertidal to 3 m) from Açores to Madeira and the Cape Verde Islands, and from Western Sahara to Senegal. The species is distributed in the whole Canary Archipelago. It was not found in Agadir nor in Gambia (pers. obs.) or in Ghana (P. Ryall pers. comm.) and in the rest of the Gulf of Guinea (in the literature). The record from Santa Helena must be confirmed to deal really with the same species.

Remarks: The soft parts of the animals from the Canary Islands are dark tobacco brown, the whitish tip of the tentacles and few whitish zones on the foot or the head being flecked of deep white dots. The sole is whitish. The same chromatism of the animal was observed in the populations from Senegal.

(Right page) Figures 28-30. *Mitrella broderipi*. 28: 5.5 mm, 55-60 m, El Hierro, WEC; 29: 24: 6.5 mm, low tide, Caleta de Abajo, Gran Canaria, JHC; 30: 7 mm, 12 m, Gando, Gran Canaria, JHC. Figures 31-36. *Anachis avaroides*. 31: 6.1 mm, 55-60 m, El Hierro, WEC; 32: 5.5 mm, 55-60 m, El Hierro, WEC; 33: 5.6 mm, 55-60 m, El Hierro, WEC; 34: 6.7 mm, 55-60 m, El Hierro, WEC; 35: 6.1 mm, 55-60 m, El Hierro, WEC; 36: 5.4 mm, 55-60 m, El Hierro, WEC.

(Página derecha) Figuras 28-30. Mitrella broderipi. *28: 5.5 mm, 55-60 m, El Hierro, WEC; 29: 24: 6.5 mm, marea baja, Caleta de Abajo, Gran Canaria, JHC; 30: 7 mm, 12 m, Gando, Gran Canaria, JHC. Figuras 31-36.* Anachis avaroides. *31: 6.1 mm, 55-60 m, El Hierro, WEC; 32: 5.5 mm, 55-60 m, El Hierro, WEC; 33: 5.6 mm, 55-60 m, El Hierro, WEC; 34: 6.7 mm, 55-60 m, El Hierro, WEC; 35: 6.1 mm, 55-60 m, El Hierro, WEC; 36: 5.4 mm, 55-60 m, El Hierro, WEC.*


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Genus *Anachis* H. and A. Adams, 1853

Type species by subsequent designation (Tate, 1868:13): *Columbella scalarina* Sowerby, 1832.

Anachis avaroides Nordsieck, 1975 (Figs. 19-27, 31-36)

Material examined: Açores: many sh, 0-15 m, FBC; 1 sh, 6 m, WEC (Fig. 20); 9 sh, 8 m, FSC. Ma: 2 sh, 9-12 m, JHC; 4 sh, 14-21 m, WEC (Fig. 21); many sh, FSC. Pa: 1 sh, 6 m, JHC (Fig. 22); 6 sh, 20-40 m, WEC; 2 sh, 40 m, FSC. Hi: 1 sh, 5-12 m, JHC; many sh, 30-60 m, WEC (Gigs 24-27, 31-36); many sh, FSC. Go: 4sh, 20-30 m, WEC (Fig. 33). Te: 2 sh WEC. GC: 1 sh, SMF syntype, stored as "holotype" (Fig. 19); 3 sh, 9-12 m, JHC. La: 1 sh, 46-50 m, FSC.

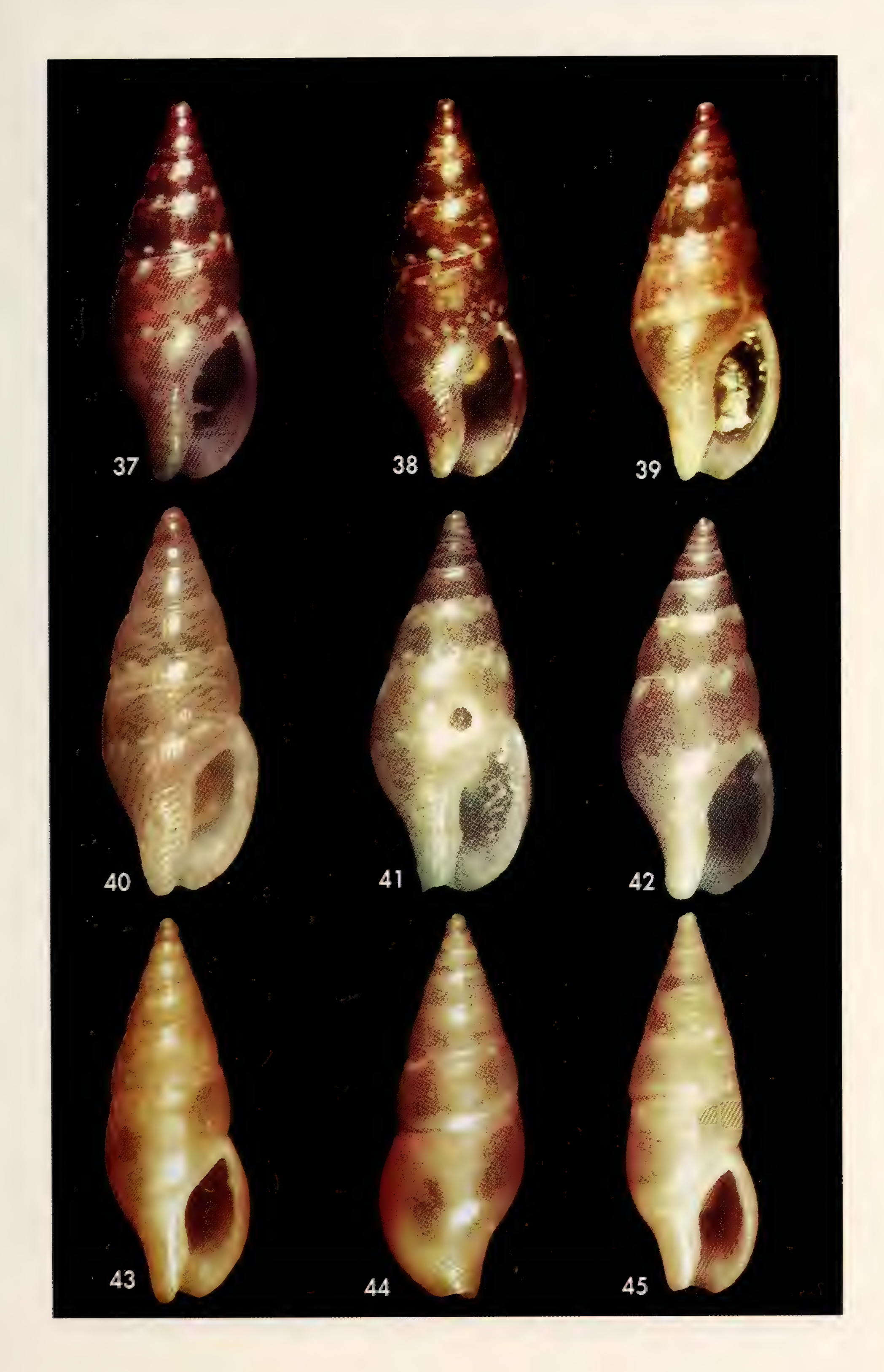
Taxonomy: *Anachis avaroides* Nordsieck, 1975 was described on the basis of a dark "grey brown" subadult shell of 6.5 x 2.5 mm (NORDSIECK, 1975: 6, fig. 29), said to come from Las Palmas (Gran Canaria), and explicitely designated as holotype in the original description (referred as collection number Nr 73.35). The original description does not deal with any paratype and does not suggest the study of further shells. The shell stored as "holotype" in SMF (Fig. 19), labelled as coming from Gran Canaria with no register or collection number, measures 7.0 x 2.75 mm and presents a light orange colour ground. This shell has the same slender stepped spire than the type-figure, the same subadult outer lip and a similar macro sculpture of axial ribs and spiral cords at the base of the last whorl. Its colour pattern shows however a spiral decoration of white marks on the shoulder and on the spiral cords at the base of the last whorl, whereas the type-figure shows only a spiral row of white marks at the middle of the last whorl. So it can be stated that the so-said SMF "holotype" is not the holotype originally designated by NORDSIECK (1975). As any revision or any new type designation did not occur about this topic, and in the wait of the possible rediscovery of the authentic holotype, it is felt to be more appropriate to consider the so-said SMF "holotype" as a simple syntype subsequently joined to the type lot by F. Nordsieck.

The original attribution of the species to the genus *Anachis* was clearly founded on the presence of strong spiral ribs. *A. avaroides* was compared by NORDSIECK (1975) to the Caribbean *A. avara* (Say, 1822), which shows however a more spindle-shaped outline, a more pointed apex, less numerous axial ribs, a more slender aperture and a more vertical outer lip (RADWIN, 1978 a: fig.3). NORDSIECK AND GARCÍA-TALAVERA (1979) picture as *"Anachis avaroides* F. Nordsieck, 1975", a shell very similar to our Fig. 25. They also picture as *"Anachis atomella* (Duclos, 1840*)"* a shell which looks like a subadult of *A. avaroides*. The type of *A. atomella*, examined in MNHN, is a very different species belonging to the Indo Pacific Province.

Curiously, NORDSIECK AND GARCÍA-TALAVERA (1979) do not give Gran

Figures 37-39. *Mitrella bruggeni*. 37: 6.6 mm, 30-55 m, El Hierro, WEC; 38: 7 mm, 30-55 m, El Hierro, WEC; 39: 6.6 mm, 30-55 m, El Hierro, WEC. Figure 40. *Mitrella broderipi*, 9 mm, 90-96 m, Arinaga, Gran Canaria, JHC. Figures 41-45. *Mitrella bruggeni*. 41: 7.9 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 42: 8.2 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 43, 44: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC; 45: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC.

Figuras 37-39. Mitrella bruggeni. *37: 6.6 mm, 30-55 m, El Hierro, WEC; 38: 7 mm, 30-55 m, El Hierro, WEC; 39: 6.6 mm, 30-55 m, El Hierro, WEC. Figura 40.* Mitrella broderipi, *9 mm, 90-96 m, Arinaga, Gran Canaria, JHC. Figuras 41-45.* Mitrella bruggeni. *41: 7.9 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 42: 8.2 mm, 46-50 m, Puerto del Carmen, Lanzarote, WEC; 43, 44: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC; 45: 9 mm, 40-60 m, Puerto de La Luz, Gran Canaria, JHC.*


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Canaria in the distribution of *A. avaroides*, but only La Palma, Selvagen and Porto Santo (Madeira). It is suggested here that the type material of *A. avaroides* may well come from La Palma, where the species is abundant in moderate depths, better than from the type locality of "Las Palmas" (Gran Canaria), where the species looks as being very scarce and as ranging at deeper levels.

Distribution: The species is known from the Açores, Madeira, Selvagen Islands and the Canary Islands, but it is not recorded from the continental shelf. Off the Açores and Madeira, shells are commonly found in the beach drift or in moderate depths (0-20 m), whereas the species is generally found at deeper level in the Canary Islands (20-60 m), rarely in shallower water. It seems that the species is somewhat common in hard bottom environments off the western Canary Islands (lower infralittoral and upper circalittoral) but very uncommon in the central and eastern Canary Islands.

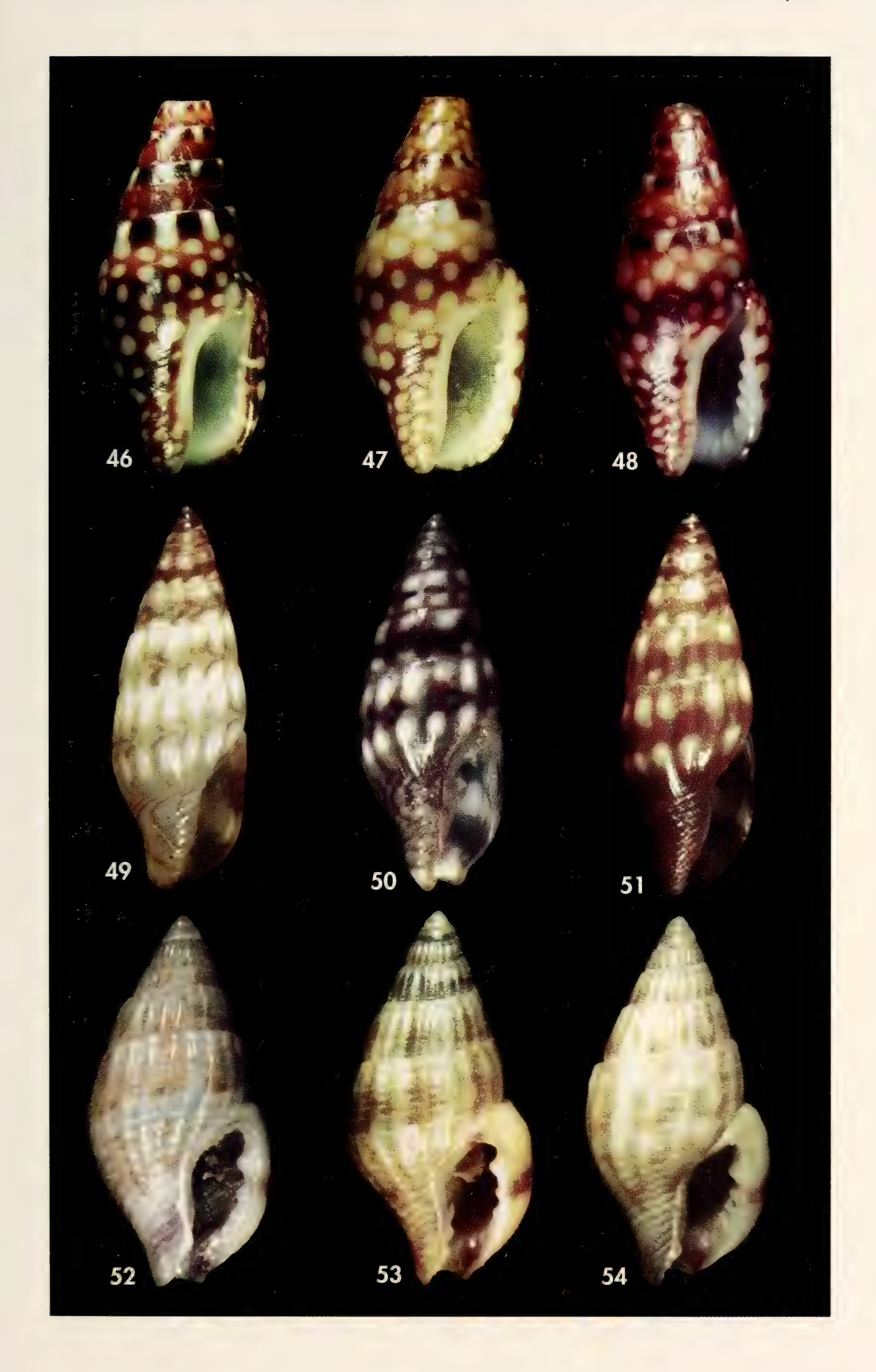
Remarks: *A. avaroides* shows as a rather variable phena. Most of the shells (Figs. 20-24, 26, 31, 34-36) are stout and thick, with strong axial ribs and a somewhat stepped outline. However, few shells show a more slender outline (Figs. 19, 25), sometimes with very faint axial ribs (Fig. 27) or just limited to the 2 or 3 first whorls (Figs. 32, 33). All the intergrades exist, even with *M. broderipi* which presents a similar range of variation of the shell outline and of the aperture (Figs. 10-18, 28-30, 40), and the same diversified patterns of the shell chromatism (Figs. 28-36). The protoconch is the same in *A. avaroides* and in *M. broderipi*.

Both phenae "*A. avaroides*" and "*M. broderipi*" have been collected together in several places, and each one looks as representing a tip of the morphologic cline of one single species. The matter remains however to be accurately verified. One of the most contradictory point lies in the fact that where *A. avaroides* is abundant (for instance in the lower infralittoral from Hierro), it is mixed with the slender "deeper form" of *M. broderipi* (Figs. 16-18) and the possible morphologic intergrades (Fig. 27) are very scarce and unclear. It must be noted that the slender "deeper form" of *M. broderipi* never suggests a tendency to axial ribbing, neither to the formation of fine spiral striae at the top of the whorls as it often occur in *A. avaroides*, even in poorly ribbed shells (Figs. 32, 33). That means that, in case where *A. avaroides* would be a "deep form" of *M. broderipi*, it would range in apparent syntopy (at least in Canary Islands) with another "deep form" of the same species without evident intergrade.

If we consider the phenetic complex "*M. broderipi / A. avaroides*" as a whole, it presents a much larger variability of the shell morphology and of the colour pattern in Madeira and in the Canary Islands (the highest variability being recorded from the western Canary Islands), whereas the populations from Alboran Sea (with only the *M. broderipi* shallow morph) and from the Açores

(Right page) Figures 46-48. *Mitrella ocellata*. 46: 9.2 mm, low tide, Tenerife, FBC; 47: 10.5 mm, low tide, Tarajalillo, Gran Canaria, FBC; 48: 10.2 mm, low tide, Tarajalillo, Gran Canaria, FBC. Figures 49-51. *Zafra exilis*. 49: 3.5 mm, 40 m, San Cristobal, Gran Canaria, J. Ferreiro Coll.; 50: 3,2 mm, 2-3 m, Pasito Blanco, Gran Canaria, FBC; 51: 3.5 mm, 40 m, San Cristobal, Gran Canaria, JHC. Figures 52-54. *Parvanachis obesa*. 52: 4.9 mm, 9 m, Santa Cruz de Tenerife, WEC; 53: 5.2 mm, 9 m, Santa Cruz de Tenerife, FSC; 54: 4.4 mm, 9 m, Santa Cruz de Tenerife, FSC.

(Página derecha) Figuras 46-48. Mitrella ocellata. *46: 9.2 mm, marea baja, Tenerife, FBC; 47: 10.5 mm, marea baja, Tarajalillo, Gran Canaria, FBC; 48: 10.2 mm, marea baja, Tarajalillo, Gran Canaria, FBC. Figuras 49-51.* Zafra exilis. *49: 3.5 mm, 40 m, San Cristobal, Gran Canaria, J. Ferreiro Coll.; 50: 3,2 mm, 2-3 m, Pasito Blanco, Gran Canaria, FBC; 51: 3.5 mm, 40 m, San Cristobal, Gran Canaria, JHC. Figuras 52-54.* Parvanachis obesa. *52: 4.9 mm, 9 m, Santa Cruz de Tenerife, WEC; 53: 5.2 mm, 9 m, Santa Cruz de Tenerife, FSC; 54: 4.4 mm, 9 m, Santa Cruz de Tenerife, FSC.*


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(with only the *A. avaroides* morph) show as much less variable. If the specific unity of this complex would be confirmed in the future, the reduced variability occurring in Alboran Sea and in the Açores may result from a "founder effect". Further inquiries are required about this topic, and in the present state we feel more appropriate to consider *A. avaroides* as a possible sibling species of *M. broderipi*.

The phena *A. avaroides* has apparently never been collected in live conditions but only as shells.

Genus *Parvanachis* Radwin, 1968

Type species by original designation: *Buccinum obesum* C.B.Adams, 1845.

Parvanachis obesa (C.B.Adams, 1845) (Figs. 52-54)

Buccinum obesum C.B.Adams, 1845

Material examined: Te: 5 sh, 9 m, WEC (Fig. 52); 5 sh, 9 m, FSC (Figs. 53, 54).

Taxonomy: *Parvanachis obesa* (C. B. Adams, 1845) was revised by RADWIN (1978 a) who characterizes the genus *Parvanachis* as gathering "the stout, prominently ribbed columbellids with inflated body whorl and heavily thickened, flaring apertural lips", all features well represented in *P. obesa*. Radwin stresses on the diagnostic feature represented by "the strongly down-hooked proximal cusp of the lateral radular tooth ", considered as typical of *Parvanachis*. In fact, *P. obesa* shows as very distinct from the *Anachis* species found in Eastern Atlantic, by its inflated body whorl, its lattice patterned sculpture, the rounded shape of the thick outer lip and the strong upper denticle.

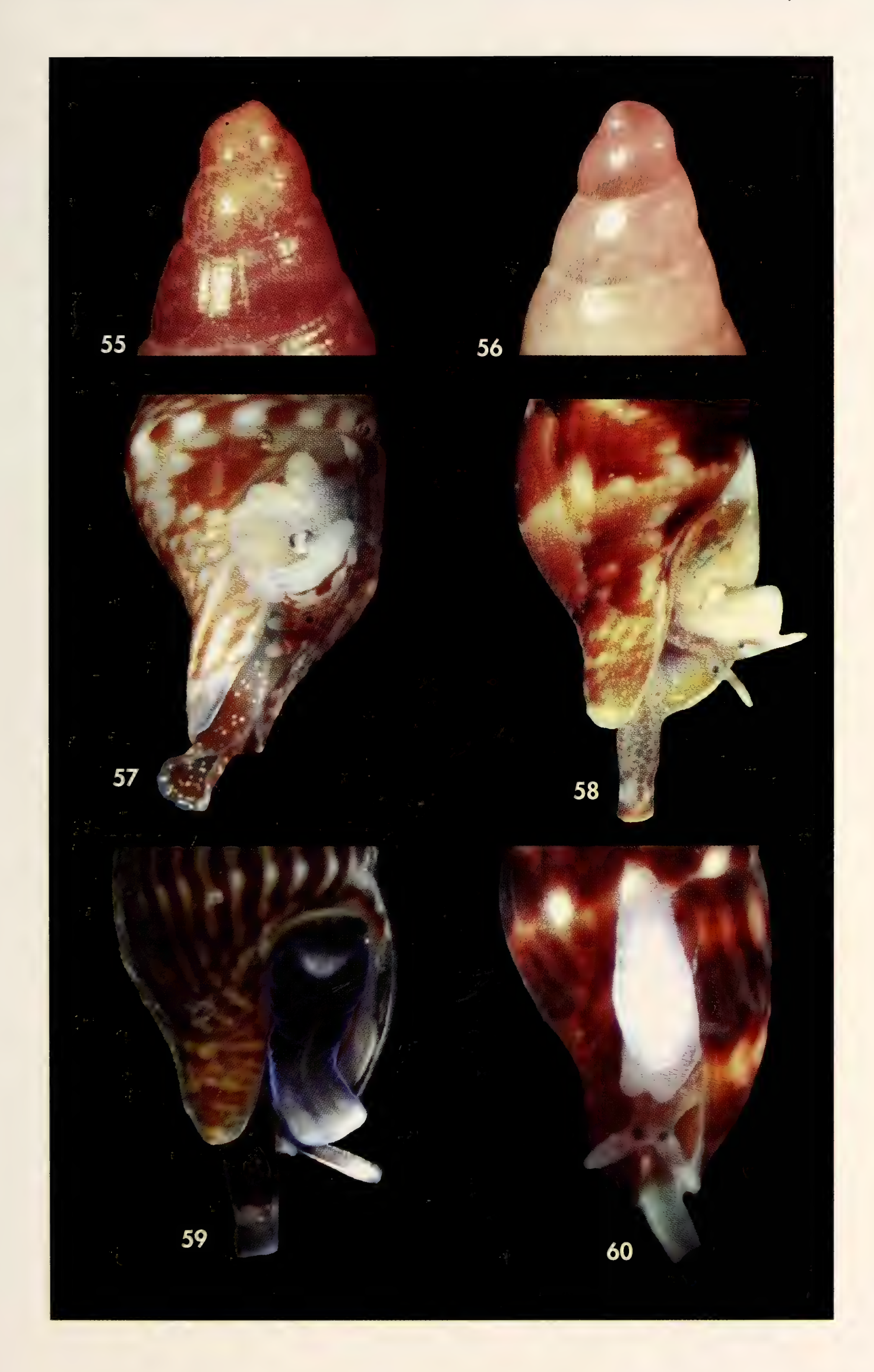
The few shells found in the harbour of Santa Cruz de Tenerife do not differ from the shells found in Lesser Antilles. The presence of *P. obesa* in Eastern Atlantic was never recorded in the literature.

Distribution: The species was described from Jamaica and it is known to have a large range in Western Atlantic, from Maryland to central Uruguay, that means well beyond the limits of the Caribbean Province. In Eastern Atlantic, the species is only known from Tenerife where few shells were collected by diving in the harbour of the main town of Santa Cruz, at a depth of 9 m (1982-1983).

Remarks: This record of *P. obesa* in Tenerife clearly corresponds to an accidental introduction by shipping. Several of the shells being in very fresh condition, some with the dry animal inside, the presence of a live population is

Figures 55, 56. *Mitrella bruggeni*, protoconchs. 55: 1-3 m, Algeciras, Andalucía, JHC; 56: 40-60 m, Puerto de la Luz, Gran Canaria, JHC. Figure 57. *Mitrella* cf. *minor*, animal, shell length 10 mm, 150 m, off northwest Gran Canaria, JHC. Figure 58. *Mitrella pallaryi*, animal, shell length 14 mm, 200 m, off northwest Gran Canaria, JHC. Figure 59. *Mitrella broderipi*, animal, shell length 7 mm, 30 m, San Cristobal, off northeast Gran Canaria, JHC. Figure 60. *Zafra exilis*, animal, shell length 3 mm, 30 m, San Cristobal, off northeast Gran Canaria, JHC.

Figuras 55, 56. Mitrella bruggeni, *protoconchas. 55: 1-3 m, Algeciras, Andalucía, JHC; 56: 40-60 m, Puerto de la Luz, Gran Canaria, JHC. Figura 57.* Mitrella *cf.* minor, *animal, largo de concha 10 mm, 150 m, noroeste de Gran Canaria, JHC. Figura 58.* Mitrella pallaryi, *animal, largo de concha 14 mm, 200 m, noroeste de Gran Canaria, JHC. Figura 59.* Mitrella broderipi, *animal, largo de concha 7 mm, 30 m, San Cristobal, noreste de Gran Canaria, JHC. Figura 60.* Zafra exilis, *animal, largo de concha 3 mm, 30 m, San Cristobal, noreste de Gran Canaria, JHC.*


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assumed. However, any new sampling was not recorded along the last twenty years, and it does not seem that the species has spread out in Tenerife or even survived in the harbour of Santa Cruz.

Genus *Zafra* A. Adams, 1860

Type species by monotypy: *Zafra mitriformis* A. Adams, 1860.

Zafra exilis (Philippi, 1849) (Figs. 49-51, 60)

Columbella exilis Philippi, 1849

Material examined: Te: 2 sh, 3-8 m, JHC. GC: 7 sh, 2-200 m, JHC (Figs. 51, 60); many sh, 2-3 m, FBC (Fig. 50); 1 sh, 40-60 m, J. Ferreiro Coll (Fig. 49).

Taxonomy: The species was cited and redescribed from the Red Sea by DRIVAS AND JAY (1997). Despite a somewhat variable decoration, the shell shows a very homogeneous morphology and cannot be confused with any of the other Indo Pacific *Zafra.*

The genus *Zafra* was revised by DRIVAS AND JAY (1990), but it remains a poorly characterized group, not clearly distinguished for instance from the genus *Seminella* Pease, 1868 and from the genus *Ascalista* Drivas and Jay, 1990.

Zafra exilis is recorded from Gran Canaria by SEGERS AND SWINNEN (2003) as the first mention of this Indo Pacific species in the Atlantic waters.

Distribution: *Z. exilis,* described from Aden, is endemic to the Red Sea and to the Gulf of Aden. First discovered as one shell in 1993 by P. Segers on the South East coast of Gran Canaria, and as live specimens in 2001 by A. M. Garcia at 5 m off Santa Cruz de Tenerife, the species is overall well settled in Gran Canaria, where live specimens were collected by both authors, by F. Swinnen and by J. Ferreiro, all around the island in shallow to deep waters.

Remarks: SEGERS AND SWINNEN (2003) explained that the perfect correspondence of the specimens collected in the Canary Islands with the material examined from the Red Sea leads to consider that the population from the Canary Islands comes from a human introduction.

We can add that this introduction is recent and that we are witnessing to the progressive settling of a new species in the Canary Islands. As a matter of fact, the species reaches shallow waters in its Indo Pacific distribution like in Canary Islands, where it constitutes currently dense settlements (for instance, at 2-3 m in algae on rocks in the small bay of Pasito Blanco and in the harbour of Arguineguin, southern Gran Canaria, FBC). So it is very unlikely that the settling of a population in Gran Canaria, where active collectors are sampling the shallow fauna regularly since the seventies, might remain undiscovered for a long. NORDSIECK AND GARCÍA-TALAVERA (1979) did not record the species and any of the assiduous collectors in the place (except P. Segers with one shell in 1993) did not find any trace of the species before the years 2000.

Because the international harbour of Las Palmas is the most evident place for an accidental introduction of such an exotic species (for example by cleaning the ballast tanks of trade ships), it can be assumed that the species has spread out from Las Palmas towards the northwestern and the southern tips of the Island. As the first discovery occurred in 1993 about 55 km south from Las Palmas, and considering the time required for the dispersion of a species supposed to have an intracapsular metamorphosis, it can be assumed that the introduction of the species dates about from the beginning of the eighties.

The animals from Gran Canaria are whitish with the nape and the sides of the foot light to dark brown (Fig. 60). The chromatism of the animals from Indo Pacific waters is unknown.

Genus *Nassarina* Dall, 1889

Type species by original designation: *Nassarina bushii* Dall, 1889.

Nassarina rietae Segers and Swinnen, 2004

Material examined: Pa: 1 sh, 42 m (paratype FSC).

Taxonomy: *Nassarina rietae* was described from 3 shells collected at 42 m off La Palma, Canary Islands. Any other record was not made about this species in the literature, and it was not found in the whole material studied in public and private collections.

N. rietae differs from the other *Nassarina* species from Western Atlantic (RADWIN, 1978 a) mainly in its rather wide subrectangular aperture with short and wide siphonal canal instead of small oval aperture with longer and narrow siphonal canal in Western Atlantic species. *N. rietae* differs from the *Nassarina* species from Senegal and Guinea Bissau (PELORCE AND BOYER, 2005) mainly in its stouter outline with much inflated whorls and in its few and very strong axial ribs with wide intervals.

Distribution: Only known from La Palma, type locality.

Remarks: *N. rietae* does not seem to belong to the Caribbean fauna, neither to the fauna from the West African Province. The single record from the isolated place of La Palma (SEGERS AND SWINNEN, 2004) suggests a local endemism better than the introduction of an Indo Pacific species. The issue remains however to be fully checked, as the hard bottoms from upper circalittoral were mainly uncollected off Canary Islands like off western Morocco and Western Sahara.

CONCLUSIONS

The columbellid fauna from the Canary Islands is made of an assemblage of species belonging to different biogeographic sets.

A first group comprises species restricted to the Lusitanian Province: *Mitrella broderipi* ranges principally from the Alboran Sea to the Canary Islands, being rare off Madeira and lacking in the Açores, whereas the closely related morph *Anachis avaroides* is restricted to the northern Macaronesian Islands (from the Açores to the Canary Islands), and *Mitrella bruggeni* ranges from the Canary Islands, northwest Morocco and Madeira to Alboran Sea, southern Italy and Tunisia (as *M. coccinea* in CHIARELLI, MICALI AND QUADRI, 2003).

A second group comprises species ranging from the latitudes of southern Morocco to a limited part of the West African province: the morph *Mitrella* cf. *minor* found off the Canary Islands extends to northern Senegal, and *Mitrella turbita* ranges from southern Canary Islands to central Senegal.

A third group comprises planktotrophic species presenting a wide but possibly fragmented distribution from the Lusitanian Province to the equatorial latitudes: *Columbella adansoni* ranging in the whole Macaronesian Archipelagos and from Sierra Leone to northern Angola, and *Mitrella pallaryi* ranging from Galicia and Mediterranean to Senegal and being found also in northern Angola. The case of *Mitrella ocellata*, ranging from Madeira to Senegal and possibly also in Santa Helena, is somewhat different, as the present distribution of this supposed amphiatlantic species may result from several different ways of spreading.

A fourth group is composed of supposed introduced species from

Caribbean or Indo Pacific origin, among which only *Zafra exilis* seems to have settled successfully. The positive record of two introduced columbellids species, the well-established *Zafra exilis* and the elusive *Parvanachis obesa*, tends to demonstrate that a high potential of introduction of tropical and subtropical species of Columbellidae occurs in the Canary Islands.

Two shells attributable to the Caribbean *Steironepion monilifera* (Sowerby, 1844) were observed in the F. Swinnen Collection, labelled as "Canary Islands, from fishermen". The poor precision of this datum and the fact that the species is not cited in the literature neither observed in other molluscan collection from the Canary Islands lead to consider this reference as not fully reliable. However, such an occurrence can be appreciated as perfectly plausible. It is possible that a local introduction of *S. monilifera* failed after few generations, like it seems to be the case for *P. obesa*. Such a situation of failed introductions can be expected as a current process, and the successful introductions, like observed with *Z. exilis*, are probably the less common result. The high frequency of accidental introductions of marine molluscs is probably under-estimated, but it can be reasonably considered as a direct by-product of the contemporary maritime economy.

The single case of possible columbellid endemism in the Canary Islands may be that of *Nassarina rietae* Segers and Swinnen, 2004, only known through 3 shells from La Palma. This finding suggests that lower infralittoral or upper circalittoral new species of Columbellidae may remain to discover off the Canary Islands, especially on hard bottoms in the most superficially explored areas, such as Fuerteventura or the lesser western Islands.

The cases of *M.bruggeni* and of the complex *M. broderipi / A. avaroides* require a clarification of the biologic status of the "deeper forms". The irregular distribution of our considered "deeper forms" (apparently absent, for instance, in the Alboran Sea) suggests that the influence of environmental factors such as the bathymetric pressure are not fully explicative of the morphologic differences at work. A relative genetic autonomy between shallow and deep populations seems to occur and would explain the relative homogeneity observed in each "bathymetric form" as well as the irregular bathymetric and geographic distributions of the morphs.

The case of *M. turbita* and of the complex *M. broderipi / A. avaroides* show that the genera *Mitrella* and *Anachis* are not separated by significant differences. The diagnostic value of the axial ribs is contested by its irregular presence in *M. turbita* and by the continuous morphologic cline represented by this feature in the complex *M. broderipi / A. avaroides*. The presence of spiral cords (irregularly represented in *A. avaroides*) and of spiral grooves (irregularly represented in *M. bruggeni*) seems to follow the same pattern. The poor reliability of these morphologic features as diagnostic criteria at the specific level leads to consider them as not reliable diagnostic criteria at the generic level.

This point must be considered like a complementary argument for a reviewing of the supraspecific classification of the Columbellidae, and like a guideline for the reinterpretation of the discriminating criteria within this family.

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La famille Columbellidae (Gastropoda: Muricoidea) dans l'infralittoral de la Péninsule du Cap Vert (Sénégal)

The family Columbellidae (Gastropoda: Muricoidea) in the infralittoral of the Peninsula of Cap Vert (Senegal)

Jacques PELORCE* et Franck BOYER**

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RÉSUMÉ

Les espèces de Columbellidae représentées dans l'infralittoral de la Péninsule du Cap Vert (Sénégal) sont étudiées sur la base de la morphologie de leur coquille et du chromatisme de leurs parties molles. Neuf espèces anciennement décrites, parfois sous des noms tombés en désuétude, sont reconnues: *Columbella rustica* Linné, 1758; *Anachis cuspidata* Marrat, 1877 avec *A. emergens* Fischer-Piette et Nicklès, 1946 comme synonyme plus récent; *A. freytagi* V. Maltzan, 1884 avec *A. bubakensis* Lamy, 1923 comme synonyme plus récent; *Parvanachis aurantia* (Lamarck, 1822) avec *C. cancellata* Gaskoin, 1851 comme synonyme plus récent; *Mitrella denticulata* (Duclos, 1840) avec *C. triangulifera* V. Maltzan, 1884 comme synonyme plus récent; *M. melvilli* (Knudsen, 1956); *M. ocellata* (Gmelin, 1791); *M. psilla* (Duclos, 1846) avec *C. japix* Duclos, 1850 comme synonyme plus récent; *M. turbita* (Duclos, 1840) avec *C. phylina* Duclos, 1846 et *C. rac* Dautzenberg, 1891 comme synonymes plus récents. L'holotype de *A. emergens* Fischer-Piette et Nicklès, 1946 est désigné comme néotype de *A. cuspidata* Marrat, 1877. Des lectotypes sont désignés pour *A. freytagi*, *M. denticulata*, *M. psilla* et *M. turbita*. La Péninsule du Cap Vert est désignée comme localité type pour *A. cuspidata*, *P. aurantia*, *M. denticulata*, *M. psilla* et *M. turbita*. Deux espèces de *Mitrella*, *M. inflata* sp. nov. et *M. fimbriata* sp. nov., et deux espèces de *Nassarina*, *N. procera* sp. nov. et *N. rolani* sp. nov., sont décrites comme nouvelles.

ABSTRACT

The species of Columbellidae represented in the infralittoral of the Peninsula of Cap Vert (Senegal) are studied on the basis of their shell morphology and of the chromatism of their soft parts. Nine species formerly described, sometimes under names fallen into disuse, are recognized: *Columbella rustica* Linné, 1758; *Anachis cuspidata* Marrat, 1877 with *A. emergens* Fischer-Piette and Nicklès, 1946 as junior synonym; *A. freytagi* V. Maltzan, 1884 with *A. bubakensis* Lamy, 1923 as junior synonym; *Parvanachis aurantia* (Lamarck, 1822) with *C. cancellata* Gaskoin, 1851 as junior synonym; *Mitrella denticulata* (Duclos, 1840) with *C. triangulifera* V. Maltzan, 1884 as junior synonym; *M. melvilli* (Knudsen, 1956); *M. ocellata* (Gmelin, 1791); *M. psilla* (Duclos, 1846) with *C. japix* Duclos, 1850 as junior synonym; *M. turbita* (Duclos, 1840) with *C. phylina* Duclos, 1846 and *C. rac* Dautzenberg, 1891 as junior synonyms. The holotype of *A. emergens* Fischer-Piette and Nicklès, 1946 is designated as neotype of *A. cuspidata* Marrat, 1877. Lectotypes are designated for *A. freytagi*, *M. denticulata*, *M. psilla* and *M. turbita*. The Peninsula of Cap

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Vert (central Senegal) is designated as type locality for *A. cuspidata, P. aurantia, M. denticulata, M. psilla* and *M. turbita*. Two species of *Mitrella, M. inflata* sp. nov. and *M. fimbriata* sp. nov., and two species of *Nassarina, N. procera* sp. nov. and *N. rolani* sp. nov., are described as new.

RESUMEN

Se estudian las especies de Columbellidae representadas en el infralitoral de la Península de Cap Vert (Senegal) en base a la morfología de las conchas y el cromatismo de partes blandas. Se reconocen como válidas nueve especies previamente descritas, algunas de ellas con nombres caídos en desuso: *Columbella rustica* Linné, 1758; *Anachis cuspidata* Marrat, 1877 con *A. emergens* Fischer-Piette y Nicklès, 1946 como sinonímia; *A. freytagi* V. Maltzan, 1884 con *A. bubakensis* Lamy, 1923 como sinonímia; *Parvanachis aurantia* (Lamarck, 1822) con *C. cancellata* Gaskoin, 1851 como sinonímia; *Mitrella denticulata* (Duclos, 1840) con *C. triangulifera* V. Maltzan, 1884 como sinonímia; *M. melvilli* (Knudsen, 1956); *M. ocellata* (Gmelin, 1791); *M. psilla* (Duclos, 1846) con *C. japix* Duclos, 1850 como sinonímia; *M. turbita* (Duclos, 1840) con *C. phylina* Duclos, 1846 y *C. rac* Dautzenberg, 1891 como sinonímias. Se designa el holotipo de *A. emergens* Fischer-Piette y Nicklès, 1946 como neotipo de *A. cuspidata* Marrat, 1877. Se designan lectotipos para *A. freytagi, M. denticulata, M. psilla* y *M. turbita*. La Peninsula de Cap Vert (centro de la costa Senegalesa) se designa como localidad tipo para *A. cuspidata, P. aurantia, M. denticulata, M. psilla* y *M. turbita*. Dos especies de *Mitrella, M. inflata* sp. nov. y *M. fimbriata* sp. nov., así como dos especies de *Nassarina, N. procera* sp. nov. y *N. rolani* sp. nov., se describen como nuevas.

MOTS CLE: Columbellidae, *Columbella, Mitrella, Anachis, Parvanachis, Nassarina*, espèce nouvelle, variabilité, diversité, Cap Vert, Sénégal.
KEY WORDS: Columbellidae, *Columbella, Mitrella, Anachis, Parvanachis, Nassarina*, new species, variability, diversity, Cap Vert, Senegal.
PALABRAS CLAVE: Columbellidae, *Columbella, Mitrella, Anachis, Parvanachis, Nassarina*, especie nueva, variabilidad, diversidad, Cap Vert, Senegal.

INTRODUCTION

L'exploration de l'infralittoral de la Péninsule du Cap Vert a permis aux auteurs de découvrir localement, dans une zone située à la rencontre des influences lusitaniennes et guinéennes, une faune de Columbellidae d'une richesse inédite pour l'Afrique de l'Ouest. Treize morphospecies ont pu être en effet séparées là où NICKLÈS (1950) n'en reconnaissait que cinq.

La grande variabilité de la plupart de ces espèces, la confusion entretenue dans la littérature autour de l'identité de plusieurs d'entre elles et la disponibilité de plusieurs noms anciens tombés en désuétude mais référables aux formes examinées ont conduit les auteurs à mener une étude systématique de la variabilité des formes représentées et à procéder à la révision de l'ensemble des taxons considérés.

Le présent article expose les résultats de ce travail, qui conduit à reconnaître comme valides dans l'infralittoral de la Péninsule du Cap Vert 9 espèces anciennement décrites et à décrire comme nouvelles 4 espèces distribuées dans la même zone.

MATÉRIEL ET MÉTHODES

Plus de 2.000 sujets de Columbellidae ont été récoltés par les auteurs au cours de 11 séjours à Dakar de 1995 à 2002 (Fig. 1). Description des stations comme suit.

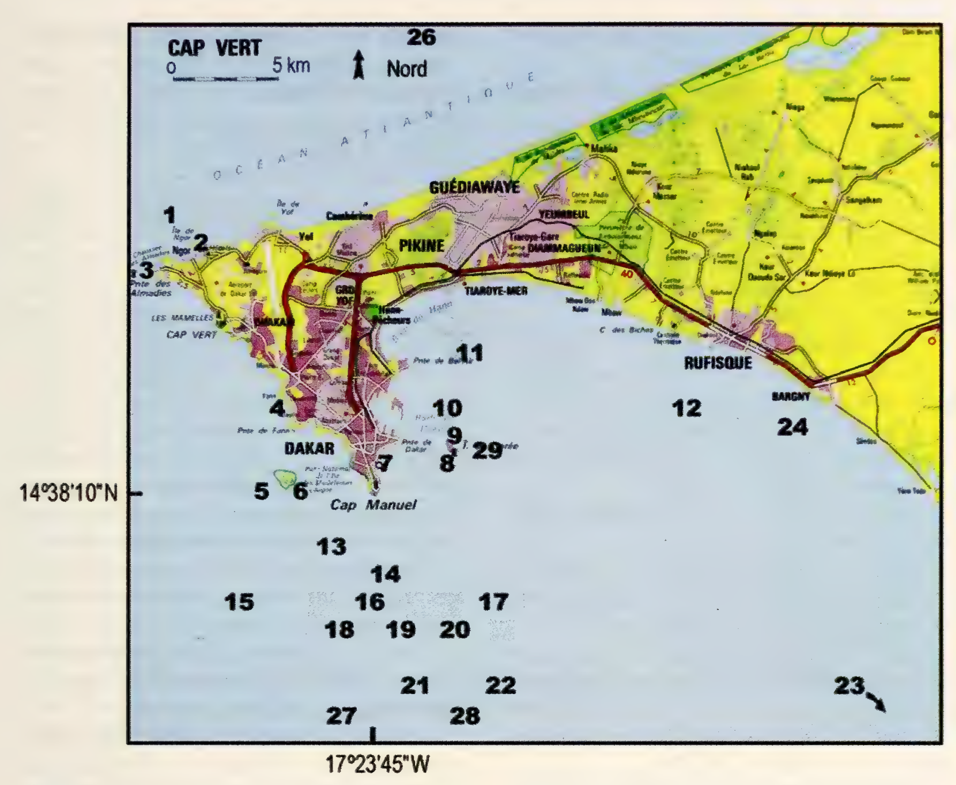


Figure 1. Stations de récoltes.
Figure 1. Sampling stations.

Sta. 1 Au large de l'île de N'Gor: 20-25 m, plateformes et tombants basaltiques.

Sta. 2 Plage devant l'île de N'Gor: 0-3 m, brossage et lavage de petits blocs.

Sta. 3 Pointe des Almadies: 0-2 m, zone des marées, tamisage et ramassage à vue, sable et rochers, lessivage d'algues calcaires et de colonies de Palytoa.

Sta. 4 Fann-Plage: 0-1 m, zone des marées, tamisage et ramassage à vue, sable et rochers.

Sta. 5 Faillis: 23 m, éperon de roches basaltiques avec poches de sable.

Sta 6 Les Madeleines: 7-20 m, tombant rocheux avec poches et sable grossier en lisière.

Sta 7 Anse Bernard: 0-2 m, zone des marées, petits et gros rochers sur sable.

Sta. 8 Les Blockaus: 10-17 m, amoncellement artificiel de rochers d'endiguement.

Sta. 9 Le Tacoma: 5-13 m, épave du début des années 40, sable coquiller en périphérie.

Sta. 10 Bel Air-Port: 10-12 m, fonds détritiques et coquilles de Pinna.

Sta. 11 Banc de Bel Air: 9-15 m, dalles calcaires et rochers bas avec algues et sable, poches importantes de coquiller détritique.

Sta. 12 Mbao, cimetière de bateaux: 0-10 m, épaves récentes sur sable vaseux.

Sta. 13 Kunakhe: 30-34 m, fond rocheux avec poches de sable,.bouquets de vers chaetoptères.

Sta. 14 Gouye Teni M'Both: 25-30 m, banc rocheux plat avec bouquets de vers.

Sta. 15 Vézo: 34-39 m, épave de plus de 50 ans sur sable coquiller.

Sta. 16 Tiwa: 30-37 m, épave de plus de 50 ans sur sable coquiller.

Sta. 17 Orstom: 32-33 m, épave récente sur sable coquiller.

Sta. 18 Séminole: 27 m, banc rocheux, bouquets de vers.

Sta. 19 Epopal: 33 m, banc de roche avec bouquets de vers et gorgones.

Sta. 20 Charbonnier: 29-34 m, épave de plus de 50 ans sur sable coquiller.

Sta. 21 Grand Thiouriba: 37-40 m, banc rocheux avec gros blocs et poches de sable, bouquets de vers.

Sta. 22 Petit Thiouriba: 30-35 m, banc rocheux avec gros blocs et poches de sable, bouquets de vers.

Sta. 23 Kunk Diabar: 30-45 m, haut-fond rocheux isolé avec poches et sable en lisière.

Sta. 24 Bargny: 5-10 m, sable vaseux avec algues.

Sta. 25 Dakar: provenance indéterminée, autour de la presqu'île du Cap Vert entre 0 et 40 m de profondeur.

Sta. 26 Guédiawaye: 37 m, fond rocheux avec poches de sable, bouquets de vers.

Sta. 27 Epave 51: 51 m; épave ancienne sur sable coquillier.

Sta. 28 Ker Diop: 46 m, fond rocheux avec poches de sable.

Sta. 29 Sud-est de Gorée: 15-20 m, dragage sur sable et débris coquilliers.

Une dizaine de récoltes à vue ont été effectuées à pied et en apnée dans les petits fonds à l'extrême nord-ouest (Pointe des Almadies) et à l'extrême sud-ouest (Fann et Anse Bernard) de la Péninsule du Cap Vert. Une centaine de récoltes ont été effectuées en scaphandre autonome par brossage sur fonds durs entre 3 et 40 mètres, la plupart dans le sud de la Péninsule, une au large de l'île de N'Gor dans le nord-ouest de la Péninsule et une autre au large de la Petite Côte, Centre Sénégal (station Kunk Diabar). Une quinzaine de demi-journées ont été consacrées à des opérations de dragage dans la Baie de Gorée, dans le sud/sud-est de la Péninsule, sur sable et débris coquilliers entre 7 et 20 m. Une vingtaine de récoltes effectuées en scaphandre autonome dans le sud de la Péninsule (10-40 m) par Haïdar El-Ali (Dakar), Patrice Petit de Voize (Quimper) et Patrick Boyer (Saint-Martin de Brome) dans la période 1998-2000 ont été mises à la disposition des auteurs. Quelques lots de coquilles provenant de la Baie de Gorée et des Almadies ont été offerts par Marcel Pin (Dakar).

Une fraction importante du matériel récolté a été étudiée et a fait l'objet de comparaisons à l'état vivant. Cette fraction du matériel a été conservée dans l'alcool (CFB), le reste du matériel (CFB et CJP) ayant été conservé à l'état sec. Dans la plupart des formes examinées, à l'exception de deux espèces spécialement élusives cantonnées dans l'infralittoral inférieur, l'animal vivant a été dessiné, photographié ou décrit, et la variation du chromatisme des parties molles a été corrélée avec la variation de la morphologie et de la décoration des coquilles. Les observations, les croquis et les notes réalisés par Emilio Rolán (Vigo) à l'occasion de deux séjours à Dakar (2002 et 2003) ont été versés à la documentation du présent travail.

Les types de Columbellidae déposés au Muséum de Paris et référables aux provinces lusitanienne et ouest-africaine ont été étudiés, ainsi que le matériel type des Columbellidae de von Maltzan confié par le Muséum de Berlin, celui de Knudsen par le Muséum de Copenhague, et les types de *Buccinum aurantium* Lamarck par le Muséum de Genève.

Acronymes et abréviations:

IRSNB Institut Royal des Sciences Naturelles de Belgique, Bruxelles.
MHNG Muséum d'Histoire Naturelle de Genève.
MNCN Museo Nacional de Ciencias Naturales, Madrid.
MNHN Muséum National d'Histoire Naturelle, Paris.
ZMK Zoologisk Museum, København.
ZMB Zoologisk Museum, Berlin.
CER Collection privée d'Emilio Rolán.
CFB Collection privée de Franck Boyer.
CJP Collection privée de Jacques Pelorce.
spm: spécimen, sujet récolté vivant.
coq: coquille, sujet récolté mort.
Sta.: station de récolte; coll: collection.

SYSTEMATIQUE

Famille COLUMBELLIDAE Swainson, 1840
Sous-famille COLUMBELLINAE Swainson, 1840
Genre *Columbella* Lamarck, 1799

Espèce type par monotypie: *Voluta mercatoria* Linné, 1758

Columbella rustica (Linné, 1758) (Fig. 11)

Purpura 1. Le Siger: Adanson, 1757 (pré-Linnéen, non-disponible).
Voluta rustica Linné, 1758: 731.
Voluta punctata Allan, 1818.
Colombella guifordia Risso, 1826.
Colombella gualteriana Risso, 1826.
Voluta tringa sensu Costa O.G., 1829 non Lamarck, 1811.
Colombella elongata Philippi, 1836.
Colombella rustica var striata Duclos, 1846.
Colombella spongiarum Duclos, 1846.
Columbella rustica var apiculata Pallary, 1900.
Columbella rustica var cuneatiformis Pallary, 1900.

Matériel type: Non examiné.
Autre matériel examiné: CJP: Sta. 1: 1 coq; Sta. 2: 70 spm; Sta. 7: 3 spm, 1 coq. CFB: Sta. 2: 20 spm, 1 coq; Sta. 3: 1 spm, 3 coq; Sta. 4: 12 spm; Sta. 7: 14 spm, 15 coq.
Localité type: Mer Méditerranée.

Description des sujets du Centre Sénégal: Coquille de taille moyenne, 10 à 14 mm, ovale, dernier tour représentant un peu plus de la moitié de la hauteur totale de la coquille, périostracum fin et pratiquement transparent, stries longitudinales sur la totalité de la coquille, protoconque paucispirée de 1.5 à 2 tours, spire haute à 5 tours convexes; décoration relativement constante, composée de taches claires ou marron clair sur fond marron foncé; ouverture étroite, labre épaissi extérieurement et renflé au milieu du bord intérieur, 6 à 9 dents labiales blanches aux intervalles teintés de marron, bord columellaire occupé par un léger cal transparent formant 3 plis.

Animal blanc laiteux à blanc crème décoré de larges plages en écharpe ambre à brunâtre. Opercule variable, de petit, blanchâtre et arrondi à grand, jaunâtre et fortement échancré.

Distribution: Méditerranée et côtes continentales de l'Est-Atlantique du Golfe Ibéro-Marocain jusqu'au Sénégal, fonds durs de la zone littorale.

Remarques: Les spécimens de Dakar (Fig. 11) correspondent parfaitement à la variété *striata* de DUCLOS (1846). Autour de la Péninsule du Cap-Vert comme dans le reste de sa distribution, *C. rustica* est principalement représentée dans la zone de balancement des marées, et très rarement en-dessous de la zone des 2-3 m. Au plan phénotypique, *C. rustica* ne se distingue de sa jumelle *C. adansoni* Menke, 1853 que par sa protoconque paucispirée suggérant un développement larvaire intracapsulaire sans stade planctotrophe (MOOLENBEEK ET HOENSELAAR, 1991). L'important polymorphisme représenté chez *C. rustica* recouvre au moins partiellement la variabilité rencontrée dans la morphologie et la décoration de la coquille de *C. adansoni*. *C. rustica* ne se distingue apparemment pas non plus de *C. adansoni* par son habitat ni par la structure de ses populations adultes. *C. adansoni* semble n'être distribuée que dans les archipels macaronésiens et le long de la côte ouest-africaine de la région guinéenne jusqu'à l'Angola, sans recouvrement avec la distribution de *C.*

rustica. Un effort supplémentaire d'observation et de récolte portant sur les populations du Sénégal reste nécessaire pour vérifier ce point définitivement, ainsi que pour apprécier si la forme *striata* Duclos peut être considérée, par comparaison avec la variabilité exprimée par l'espèce en Méditerranée, comme rendant compte d'une forme géographique affirmée détenant un statut de sous-espèce.

Sousfamille PYRENINAE Suter, 1909
Genre *Anachis* H. et A. Adams, 1853

Espèce type par désignation subséquente (Tate, 1868): *Columbella scalarina* Sowerby, 1832

Anachis cuspidata Marrat, 1877 (Figs. 10, 30-38)

Columbella (Anachis) cuspidata Marrat, 1877. *Quarterly Journal of Conchology*, 1: 42.
Pyrene (Anachis) emergens Fischer-Piette et Nicklès, 1946. *Journal de Conchyliologie*, 87: 61-62.

Matériel type: Le matériel type de *Anachis cuspidata* est perdu (Mc MILLAN, 1985: appendix). Le matériel type de *Anachis emergens* (MNHN) est constitué d'un holotype de 9 mm provenant de la Collection Adanson (Fig. 30) et de 22 paratypes d'un autre lot mesurant de 7 à 8.5 mm (Figs. 31, 32). L'holotype de *A. emergens* est désigné ici comme néotype de *A. cuspidata*.
Autre matériel examiné: CJP: Sta. 1: 1 spm; Sta. 2: 92 spm, 1 coq; Sta. 5: 1spm, 1 coq; Sta. 6: 1 spm; Sta. 9: 4 coq; Sta. 14: 1 spm; Sta. 15: 6 spm, 32 coq; Sta. 16: 7 spm, 9 coq; Sta. 23: 5 spm, 52 coq. CFB: Sta. 2: 19 spm; Sta. 3: 9 spm; Sta. 6: 1 spm; Sta. 7: 6 spm, 1 coq; Sta. 13: 6 spm; Sta. 14: 5 spm, 1 coq; Sta. 15: 1 spm; Sta. 16: 3 spm; Sta. 18: 27 spm, 1 coq; Sta. 21: 6 spm; Sta. 22: 42 spm, 7 coq; Sta. 26: 37 spm, 16 coq; Sta. 27: 3 spm; Sta. 28: 1 spm.
Localité type: « Afrique de l'Ouest ». La Péninsule du Cap Vert, Centre Sénégal, est ici proposée comme localité type plus pertinente.

Description originale: "C. testa elongato-fusiformi, utrinque attenuata, spira cuspidata; anfractibus longitudinaliter costatis et transversim sulcatis, costis subgranulatis; fulva fusco maculata vel pallide cinerea, epidermide leucophoea; columella arcuata, labio cum callo circumscripto tecto; apertura angusta; labro intus lirato.

Hab. West Africa. Captain Davis".

Description complémentaire: Coquille de petite taille, 7 à 8 mm, de forme allongée, légèrement ventrue, environ 1.5 tour de protoconque et 5 tours de téléoconque; 20 à 22 côtes axiales sur le dernier tour, intervalles légèrement plus étroits que les côtes, minces cordons spiraux dans les intervalles chevauchant plus ou moins les côtes en conférant souvent à celles-ci un aspect granuleux vers la base et prés de la suture, côtes axiales et cordons spiraux s'estompant au niveau de l'ouverture, 10 sillons spiraux à la base; décoration variable, composée de taches marron plus ou moins foncées sur fond blanchâtre, protoconque blanc crème avec petites taches marrons, périostracum transparent; ouverture étroite, bord columellaire présentant un cal bien défini et étroit portant 4 ou 5 plis, bord interne du labre épaissi dans son milieu et portant 5 ou 6 dents, canal siphonal court et légèrement vrillé.

L'animal présente une couleur de fond blanchâtre à jaunâtre pâle avec une décoration variable de marques brun léger à noirâtre un peu étirées dans le sens de la longueur, souvent plus morcelées, marbrées ou arrondies sur les bords du pied, liste dorsale et nuque plus foncées, taches parfois mordorées sur le siphon avec anneau sombre vers l'extrémité, moucheté de blanc sur tentacules, extrémité du siphon et sole, qui peut être faiblement marbrée de noir ou de brun sur le bord latéral. Opercule jaunâtre faiblement moucheté de noir.

Certains spécimens de profondeur (Fig. 38) possèdent une coquille légère-



Figure 2. *Colombella turbita,* planche 2 de DUCLOS (1840), figure type. Figure 3. *Colombella phylina,* planche 15 de DUCLOS (1846), figure type. Figure 4. *Colombella denticulata,* planche 9 de DUCLOS (1840), figure type. Figure 5. *Buccinum aurantium,* planche 25 de KIENER (1834). Figure 6. *Colombella psilla,* planche 15 de DUCLOS (1846), figure type. Figure 7. *Colombella japix,* planche 22 de DUCLOS (1850), figure type. Figure 8. *Clathurella polignaci* Lamy, 1923, figure type. Figure 9. *Columbella (Anachis) bubakensis* Lamy, 1923, figure type. Figure 10. "Le Rac non publié" in FISCHER-PIETTE (1942), figure type de *Pyrene* (*Anachis*) *emergens* Fischer-Piette et Nicklès, 1946.

Figure 2. Colombella turbita, *plate 2 in DUCLOS (1840), type figure. Figure 3.* Colombella phylina, *plate 15 in DUCLOS (1846), type figure. Figure 4.* Colombella denticulata, *plate 9 in DUCLOS (1840), type figure. Figure 5.* Buccinum aurantium, *planche 25 in KIENER (1834). Figure 6.* Colombella psilla, *plate 15 in DUCLOS (1846), type figure. Figure 7.* Colombella japix, *plate 22 in DUCLOS (1850), type figure. Figure 8.* Clathurella polignaci *Lamy, 1923, type figure. Figure 9.* Columbella (Anachis) bubakensis *Lamy, 1923, type figure. Figure 10. "Le Rac non publié" in FISCHER-PIETTE (1942), type figure of* Pyrene (Anachis) emergens *Fischer-Piette and Nicklès, 1946.*

ment translucide de couleur miel uniforme. Les caractères conchyliologiques de ces spécimens et le chromatisme de l'animal sont néanmoins strictement identiques à ceux des spécimens littoraux, et ces différentes formes sont considérées comme conspécifiques. La variabilité des coquilles dans les populations de l'infralittoral supérieur porte moins sur la morphologie de la coquille que sur la décoration de celle-ci (Figs. 33, 38). Les granulosités représentées sur la coquille de certaines populations littorales sont bien apparentes chez les paratypes de *A. emergens* (Figs. 31, 32).

Distribution: L'espèce est uniquement connue de la Péninsule du Cap Vert, Centre Sénégal, 0-40 m. Elle n'a pas été reconnue de la région de Nouadhibou, dans le nord mauritanien (comm. pers. d'E. Rolán), ni de la Gambie (obs. pers. du second auteur).

Habitat: Fonds durs, sous pierres avec tapis d'algues courtes et frondes d'algues calcaires sur plages fossiles ou sur blocs basaltiques.

Remarques: A partir d'un lot de coquilles ramenées par le Capitaine Davis d'un voyage effectué de Madère jusqu'au Golfe de Guinée, MARRAT (1877) décrit *Columbella (Anachis) cuspidata* comme espèce nouvelle de l'Afrique de l'Ouest. La description originale, reproduite ci-dessus, n'est accompagnée d'aucune illustration et d'aucun commentaire. L'espèce sera citée par PACE (1902) sans tentative de révision.

FISCHER-PIETTE (1942) retrouvera dans la collection Adanson une coquille collée sur un carton-cuvette portant l'inscription "2,482, Buccin 4 Rac, hist. Nat. Du Seneg.". Cette coquille est citée par Fischer-Piette comme "le Rac non publié" (Fig. 10), par opposition avec « Le Rac décrit et figuré », et elle est rapprochée de l'espèce *strenella* Duclos de la région indo-pacifique. Fischer-Piette écarte *C. cuspidata* de la comparaison avec la coquille d'Adanson, considérant ce taxon comme correspondant à une "espèce ouest-africaine, décrite trop sommairement et non figurée".

FISCHER–PIETTE ET NICKLES (1946), se fondant sur l'étude complémentaire d'un lot de 22 coquilles obtenues plus récemment de Dakar, créeront le taxon *Pyrene (Anachis) emergens* pour désigner l'espèce relatée plus tôt par FISCHER–PIETTE (1942) comme "le Rac non publié", le spécimen de la collection Adanson étant désigné comme holotype d'*A. emergens*. Cette nouvelle espèce est comparée aux taxa spécifiques *strenella* Duclos, *sparsa* Reeve, *suffusa* Sowerby et *cuspidata* Marrat, considérés comme synonymes possibles d'*emergens*.

Discussion: La description de *A. cuspidata*, attribuée par MARRAT (1877) à l'Afrique de l'Ouest, même si elle est relativement brève et non illustrée, correspond sans ambiguité à l'espèce décrite ultérieurement du Sénégal comme *A. emergens* par FISCHER–PIETTE ET NICKLES (1946). Bien que le nom de *A. cuspidata* soit tombé en désuétude, la règle d'inversion de la précédence ne s'applique pas ici, le taxon *emergens* ayant été employé dans moins de 25 travaux publiés par moins de 10 auteurs dans les 50 ans qui viennent de s'écouler (Art. 23.9.1 du Code de Nomenclature Zoologique). Par conséquent le nom *cuspidata* Marrat, 1877 doit être considéré comme nom valide de l'espèce, avec *emergens* Fischer-Piette et Nicklès, 1946 comme synonyme plus récent. Le type de *cuspidata* étant perdu, nous désignons l'holotype de *C. emergens* (MNHN, Collection Adanson) comme néotype de *A. cuspidata* Marrat. Les taxa spécifiques *strenella* Duclos, *suffusa* Sowerby et *sparsa* Reeve correspondent à des espèces indo-pacifiques et n'appartiennent pas à la synonymie de *A. cuspidata*.

Anachis freytagi von Maltzan, 1884 (Figs. 9, 21-29)

Columbella (Anachis) freytagi von Maltzan, 1884. Diagnosen neuer Senegambischer Gastropoden, *Nahrichtsblatt der deutschen Malakozoologischen Gesellschaft*, 5: 72.

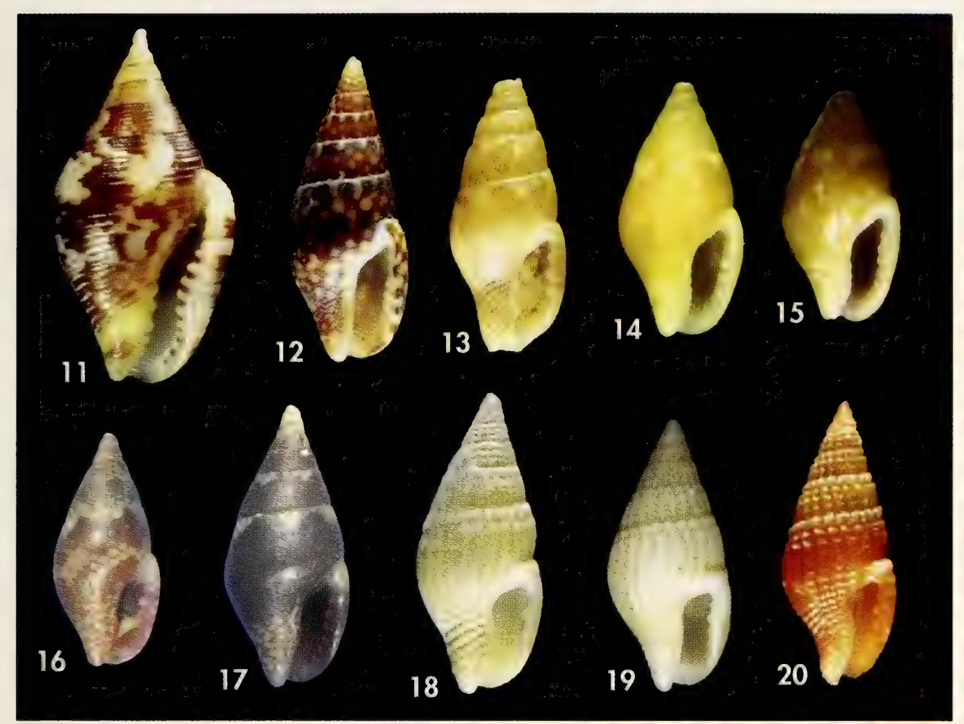


Figure 11. *Columbella rustica*, plage de N'Gor, 13.9 mm (CJP). Figure 12. *Mitrella ocellata*, plage de N'Gor, 11.4 mm (CJP). Figure 13. *Mitrella melvilli*, Vézo, 7.2 mm (CJP). Figures 14-17. *Mitrella denticulata*. 14: lectotype 6.8 mm (MNHN); 15: syntype de *C. triangulifera*, 5.9 mm (ZMB); 16, 17: Cap Vert, 6 et 7.5 mm (CJP). Figures 18-20. *Parvanachis aurantia*. 18: syntype probable, 8.7 mm, Coll. Lamarck (MHNG); 19: 7.6 mm, Coll. Duclos (MNHN); 20: Vézo, 7.7 mm (CJP).
Figure 11. Columbella rustica, *N'Gor beach, 13.9 mm (CJP). Figure 12.* Mitrella ocellata, *N'Gor beach, 11.4 mm (CJP). Figure 13.* Mitrella melvilli, *Vézo, 7.2 mm (CJP). Figures 14-17.* Mitrella denticulata. *14: lectotype 6.8 mm (MNHN); 15: syntype of* C. triangulifera, *5.9 mm (ZMB); 16, 17: Cap Vert, 6 and 7.5 mm (CJP). Figures 18-20.* Parvanachis aurantia. *18: probable syntype, 8.7 mm, Coll. Lamarck (MHNG); 19: 7.6 mm, Coll. Duclos (MNHN); 20: Vézo, 7.7 mm (CJP).*

Columbella (Anachis) bubakensis Lamy, 1923. Campagne du Sylvana, Mission du Comte Jean de Polignac et de Mr Louis Gain Mollusques Testacés. *Compte rendu du Congrés des Sociétés savantes en 1922*:. 13-14.

Matériel type: 5 syntypes (4 adultes et un juvénile) ZMB, Moll. 37022: le mieux conservé d'entre eux (7 mm) est sélectionné ici comme lectotype (Fig. 21), les 4 paralectotypes (Fig. 22) mesurent de 5.9 à 7 mm. Holotype de *C. bubakensis* (7.2 mm) au MNHN (Fig. 23).
Autre matériel examiné: CJP: Sta. 1: 2 spm, 1 coq; Sta. 6: 11 spm; Sta. 9: 169 spm, 47 coq; Sta. 14: 1spm; Sta. 15: 1spm, 27 coq; Sta. 16: 1 spm, 8 coq; Sta. 21: 1 spm; Sta. 23: 13 spm, 4 coq. CFB: Sta. 6: 20 spm; Sta. 9: 10 spm, 46 coq; Sta. 10: 45 spm; Sta. 13: 3 spm; Sta. 17: 2 spm; Sta. 21: 1 spm; Sta. 26: 5 coq; Sta. 29: 6 coq.
Localité type: Gorée, Sénégal.

Description: Coquille de petite taille, 6 à 8 mm, allongée, spire pointue, protoconque à 1.5 tour, blanche avec bande marron, dernier tour de la coquille représentant 45 % de la hauteur totale, suture bien marquée, tours pratiquement plats; 13 à 22 côtes verticales légèrement sigmoides atténuées vers la base

des tours, minces cordons spiraux dans les intervalles, parfois absents; periostracum fin et transparent, couleur de fond variable jaune à marron violacé, le plus souvent brun tabac, avec ou sans taches blanches, régulières ou irrégulières; ouverture étroite, sinus paléal et 6 dents sur un labre épais avec renflement extérieur, cal columellaire bien marqué et étroit portant 5 à 7 plis, canal siphonal court et légèrement vrillé.

L'animal blanchâtre est décoré de marbrures noires, plus denses et plus foncées sur le corps que sur le dessus du pied, le front entre les pédoncules oculaires est noir, comme la partie interne des tentacules et les bords latéraux supérieurs de la sole. Les parties noires peuvent être fragmentées en segments courts et minces accotés pour former des bandes ou des taches organisées dans le sens longitudinal. Siphon décoré de taches noires régulières et d'un anneau terminal de la même couleur, le fond blanchâtre tendant à devenir noirâtre dans sa partie distale. Moucheté de blanc sur les côtés et sur les bords du pied ainsi que vers l'extrémité des tentacules. Dessous de la sole blanchâtre à grisâtre avec taches noires sur les bords. Opercule jaunâtre, ovale arrondi, parfois étiré dans sa moitié arrière ou dentelé dans sa partie avant, zone d'attachement noire en forme de selle dans la moitié antérieure.

Distribution: De la Péninsule du Cap Vert, Centre Sénégal, jusqu'aux Iles Bissagos, Guinée-Bissau.

Habitat: Abondante sur tous les fonds durs et intermédiaires de 10 à 40 mètres.

Remarques: *Anachis freytagi* montre une grande variabilité concernant le nombre et le relief des côtes axiales et des cordons spiraux (les côtes pouvant être très atténuées et les cordons absents chez certains sujets) comme pour la décoration de la coquille. Le type de *C. bubakensis* (Figs. 9, 23) appartient clairement à la variabilité de *A. freytagi* (Figs. 24-29).

Genre *Parvanachis* Radwin, 1968

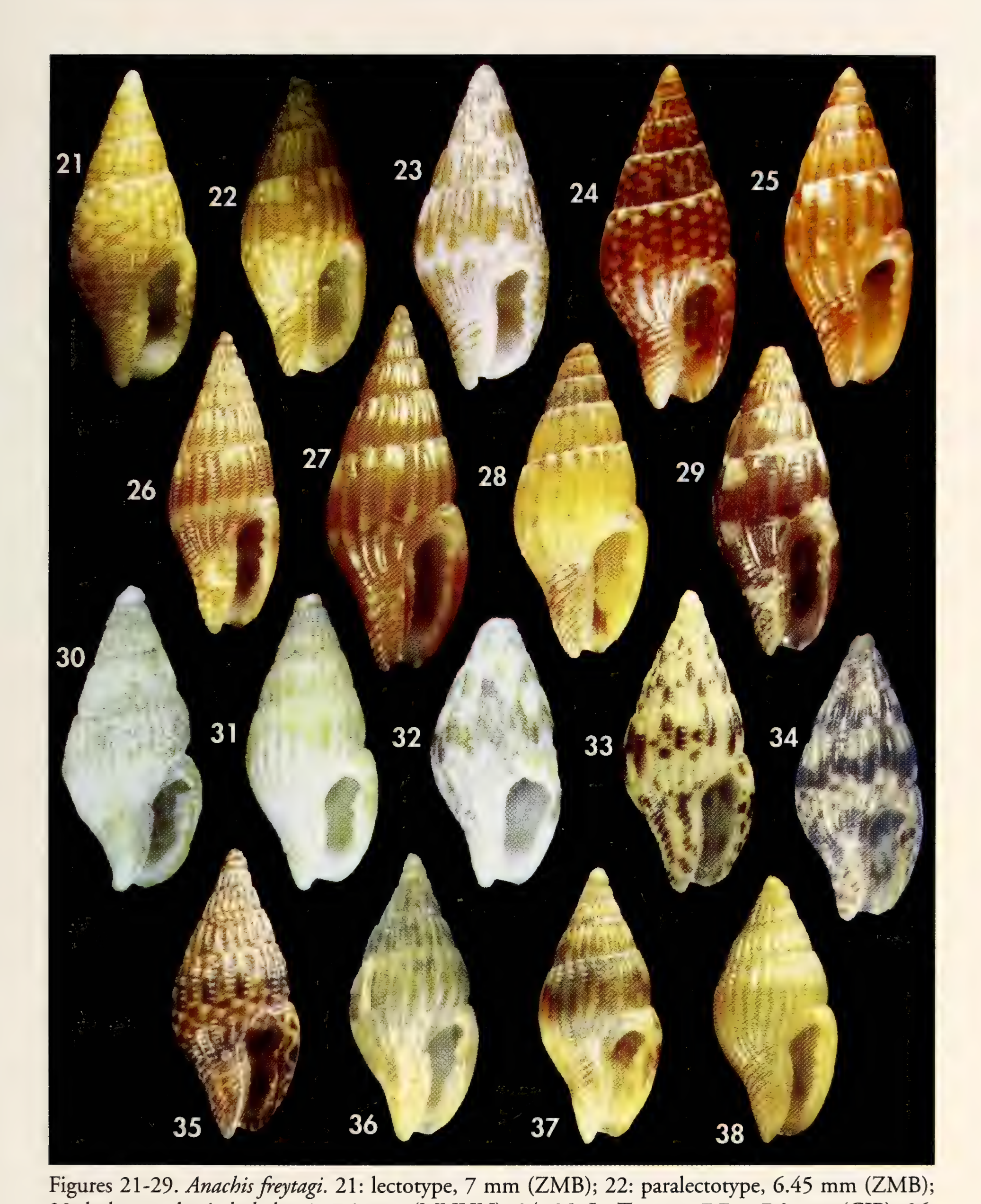
Espèce type par désignation originale: *Buccinum obesum* C.B. Adams, 1845

Parvanachis aurantia (Lamarck, 1822) comb. nouv. (Figs. 5, 18-20)

Buccinum 3. Le Nisot: Adanson, 1757 (pré-Linnéen, non-disponible).
Buccinum aurantium Lamarck, 1822. *Histoire Naturelle des animaux sans vertèbres*, 7: 275.
Buccinum aurantium Lam.: Kiener, 1834. *Spécies Général et Iconographie des Coquilles Vivantes, Famille des Purpurifères*, Deuxième Partie, 1834-1841: 50.
Colombella aurantia Lam.: Duclos, 1840. *Histoire Naturelle Générale et Particulière de tous les genres de Coquille Univalves Marines.* Genre *Colombella.* Planche 7.
Columbella cancellata Gaskoin, 1851. Description of twenty species of Columbellae, and one species of Cypraea. *Proc. Zool. Soc. London*, 19: 6.

Matériel type: 14 syntypes probables MHNG 1452/95 (7 à 8.7 mm) (Fig. 18).
Autre matériel examiné: Collection Duclos (MNHN): 10 coq. CJP: Sta. 1: 2 coq; Sta. 2: 3 spm; Sta. 6: 2 coq; Sta. 8: 3 coq; Sta. 9: 7 spm, 6 coq; Sta. 12: 1 coq; Sta. 14: 3 spm, 1 coq; Sta. 15: 1 coq; Sta. 16: 1 juv; Stra. 22: 2 juv; Sta. 23: 5 spm, 7 coq. CFB: Sta. 2: 2 spm; Sta. 3: 2 spm, 3 coq; Sta. 6: 3 spm; Sta. 7: 25 spm; Sta. 9: 4 spm, 20 coq; Sta. 13: 9 spm; Sta. 14: 9 coq; Sta. 18: 13 spm; Sta. 21: 1 spm; Sta. 22: 15 spm, 9 coq; Sta. 26: 11 coq; Sta. 28: 1 spm.
Localité type: «Mon cabinet». Selon Kiener, l'espèce «habite les côtes de l'île de Java». La Péninsule du Cap Vert, Centre Sénégal, est désignée ici comme nouvelle localité type de *Buccinum aurantium* Lamarck.

Description originale: «*Buccinum aurantium*. B. testa minima, ovato-acuata, longitudinaliter es tenuissime plicata, obsoleta decussata, luteo-aurantia, apica rubra, anfractibus convexo-planis; apertura angustiuscula».



Figures 21-29. *Anachis freytagi*. 21: lectotype, 7 mm (ZMB); 22: paralectotype, 6.45 mm (ZMB); 23: holotype de *A. bubakensis*, 7.2 mm (MNHN); 24, 25: Le Tacoma, 7.7 et 7.3 mm (CJP); 26: Gouye Teni M'Both, 7 mm (CJP); 27-29: Le Tacoma, 8.2, 7.4 et 7 mm (CJP). Figures 30-38. *Anachis cuspidata*. 30: néotype de *A. cuspidata,* holotype de *A. emergens*, 9 mm (MNHN); 31, 32: paratypes de *A. emergens*, 8 et 7 mm (MNHN); 33: N'Gor, 8 mm (CJP); 34: Les Madeleines, 7.5 mm (CJP); 35, 36: N'Gor, 7.5 et 7.5 mm (CJP); 37, 38: Tiwa, 7.2 et 7 mm (CJP).

Figures 21-29. Anachis freytagi. *21: lectotype, 7 mm (ZMB); 22: paralectotype, 6.45 mm (ZMB); 23: holotype of* A. bubakensis, *7.2 mm (MNHN); 24, 25: Le Tacoma, 7.7 and 7.3 mm (CJP); 26: Gouye Teni M'Both, 7 mm (CJP); 27-29: Le Tacoma, 8.2, 7.4 and 7 mm (CJP). Figures 30-38.* Anachis cuspidata. *30: neotype of* A. cuspidata, *holotype of* A. emergens, *9 mm (MNHN); 31, 32: paratypes of* A. emergens, *8 and 7 mm (MNHN); 33: N'Gor, 8 mm (CJP); 34: Les Madeleines, 7.5 mm (CJP); 35, 36: N'Gor, 7.5 and 7.5 mm (CJP); 37, 38: Tiwa, 7.2 and 7 mm (CJP).*

Description complémentaire: Selon KIENER (1834): "Coquille très petite, ovale, oblongue, atténuée aux extrémités, colorée de jaune orangé; spire pointue, composée de sept tours subconvexes, chargés sur toute leur surface de plis longitudinaux nombreux, entrecroisés de stries fines, transverses et rapprochées. Les stries du dernier tour un peu plus fortement prononcées vers la base. Les sutures ornées, prés du bord, d'une rangée de petites granulations séparées par un sillon transverse. Ouverture blanchâtre, ovale, étroite, rétrécie à la base; lèvre droite dentelée".

Il convient d'ajouter que la taille de la coquille varie de 7 à 9 mm, que la couleur de la téléoconque varie du beige orangé à l'orange soutenu et que la protoconque vitreuse à deux tours est toujours rosée à rose vif.

Animal orange vif moucheté de blanc cru, pied plus étroit que dans les autres espèces. Opercule jaune moyen à corne pâle.

Distribution: Espèce uniquement connue par des populations peu abondantes distribuées autour de la Péninsule du Cap Vert, sur fonds durs de 0 à 40 m.

Remarques: *Buccinum aurantium* a été décrit par Lamarck en 1822 sans illustration et sans localité, mais en référence aux figures 1188 et 1189 de Martini, 1780. Ces figures sont très petites et confuses et ne permettent pas l'identification. KIENER (1834) redécrit *Buccinum aurantium* avec deux figures explicites (Fig. 5), sur la base principalement du matériel de Lamarck. Un lot de 14 coquilles homogènes (Fig. 18) de la collection Lamarck-Massena-Delessert (MHNG) correspondant à la description et aux figures de Kiener et compatibles avec la description de Lamarck, doit être considéré comme un lot de syntypes probables de *B. aurantium*, même si ce lot pourrait comporter quelques sujets ajoutés ultérieurement au matériel original de Lamarck. Les coquilles de la collection Duclos (Fig. 19) identifiées et figurées par celui-ci comme *C. aurantia* et la description originale du taxon *Columbella cancellata* Gaskoin, 1851 correspondent aussi à notre espèce sénégalaise.

Genre *Mitrella* Risso, 1826

Espèce type par désignation subséquente (Cox, 1927): *Mitrella flaminea* Risso, 1826 [= *Mitrella scripta* (Linné, 1758)]

Mitrella denticulata (Duclos, 1840) (Figs. 4, 14-17)

Buccinum 2. Le Jol: Adanson, 1757 (pré-Linnéen, non-disponible).
Colombella denticulata Duclos, 1840.
Columbella triangulifera V. Maltzan, 1884.

Matériel type: 9 syntypes de *C. denticulata* Duclos au MNHN: l'un des mieux préservés d'entre eux (6.8 mm) est désigné ici comme lectotype (Fig. 14), les paralectotypes mesurent 6 à 7 mm. 2 syntypes de *C. triangulifera* V. Maltzan (5.8 et 5.9 mm) au ZMB, Moll. 37058 (Fig. 15).
Autre matériel examiné: CJP: Sta. 1: 1 spm, 2 coq; Sta. 5: 1 spm; Sta. 6: 6 spm, 7 coq; Sta. 7: 3 spm, 2 coq, Sta. 8: 7 coq; Sta. 9: 75 spm, 11 coq; Sta. 23: 6 spm; Sta. 24: 1 coq; Sta. 25: 9 spm. CFB: Sta. 2: 2 spm; Sta. 3: 3 spm, 6 coq; Sta. 6: 57 spm; Sta. 7: 200 spm; Sta. 9: 81 spm, 17 coq; Sta. 18: 23 spm, 1 coq; Sta. 22: 1 coq.
Localité type: Inconnue. La Péninsule du Cap Vert, Centre Sénégal, est désignée ici comme localité type de *C. denticulata* Duclos.

Description: Coquille de petite taille, 6 à 7.5 mm, ventrue, dernier tour représentant environ 65% de la hauteur totale de la coquille, tours légèrement arrondis vers le bas, suture nette; sculpture ne comportant que 7 à 8 sillons sur la partie inférieure du dernier tour; ouverture étroite, labre épaissi extérieurement portant 5 à 7 dents,

cal columellaire transparent, ne dépassant pas l'ouverture, portant quelques plis très peu marqués; décoration variant du marron au violet intense en passant par le rose clair, présence de points blancs organisé sous forme de bandes au milieu du dernier tour et sur la partie inférieure au niveau des sillons, groupés en masses triangulaires sous la suture, conférant à celle-ci une allure festonnée; protoconque à 1.5 tour, brune avec sommet blanc.

Animal blanchâtre presque entièrement recouvert de nappes marron clair à brun noirâtre, avec quelques lacunes sur l'avant, l'arrière ou les côtés du pied, sole supérieure blanchâtre avec zone mauve pâle sur le bord latéral avant, dessous de la sole blanc, tour de l'œil et pointe des tentacules blancs, zones blanches mouchetées de blanc cru, sauf autour de l'œil. Opercule ovale arrondi à étiré, jaune soutenu avec longue zone d'attachement brune formant un croissant périphérique.

Distribution: Cette espèce est représentée par des populations localement abondantes autour de la Péninsule du Cap Vert, sur fonds durs entre 0 et 40 m.

Remarques: FISCHER-PIETTE (1942) identifie *C. denticulata* comme espèce valide du Sénégal, place *C. triangulifera* Maltzan, 1884 en synonymie et attribue l'espèce au «sous-genre» *Mitrella*. La variabilité réduite de l'espèce est vérifiée aussi bien dans le matériel type (Fig. 14) et dans les figures types (Fig. 3) que chez les syntypes de *C. triangulifera* (Fig. 15) et dans l'abondant matériel collecté à Dakar (Figs. 16, 17).

Mitrella melvilli (Knudsen, 1956) comb. nouv. (Fig. 13)

Pyrene melvilli Knudsen, 1956 Marine Prosobranchs of Tropical West Africa (Stenoglossa). *Atlantide Report*, 4: 33-34.

Matériel type: Holotype ZMK (8.9 x 3.4 mm).
Autre matériel examiné: CJP: Sta. 15: 1 coq., CFB: Nord Sénégal: 1 coq.
Localité type: Guinée Française.

Description originale: «The shell has about 9 1/4 whorls, a rather high and pointed apex. Apart from 10 spiral ridges on the basal part of the body whorl and closely set and very faint growth lines, the shell is entitely devoid of sculpture, but is somewhat shining. There does not appear to be any demarcation between the protoconch and the adult shell. The suture is rather deeply incised. Aperture small. Columellar side with a reflected callus and 5 indistinct denticles. Outer lip straight and almost parallel to the columella, with a somewhat thickened varix and a distinct but slightly developed sinus near the suture. Interior with 6 distinct denticles. Siphon broad and short. Colouration: upper part of the shell brown with indistinct brown and whitish spots near the upper suture».

Animal et opercule non observés.

Distribution: Connue du Nord Sénégal (CFB) jusqu'au Sud Angola (comm. pers. d'E. Rolán).

Remarques: Cette espèce est replacée dans le genre *Mitrella*, car elle ne possède pas la coquille biconique ni le fort cordon subsutural qui caractérisent le genre *Pyrene*, et montre en revanche toutes les caractéristiques morphologiques de *M. scripta* (Linné, 1758), espèce type de *Mitrella*.

Une seule coquille correctement conservée de cette espèce (Fig. 13), sans protoconque, a été trouvée dans nos récoltes, provenant d'un niveau profond (35 m). Une coquille subfossile attribuable à *M. melvilli* a été draguée au large de Lompoul (150 m), Nord Sénégal, par M. Pin en 1991 (CFB). Ce dernier signalement constitue la localité la plus septentrionale connue pour l'espèce. L'holotype provenant lui-même de 32 m, il semble s'agir d'une espèce à distribution bathymétrique assez profonde, tout au moins dans la région d'influence guinéenne (infralittoral inférieur et circalittoral supérieur).

Mitrella ocellata (Gmelin, 1791) (Fig. 12)

Buccinum 1. Le Barnet: Adanson, 1757 (pré-Linnéen, non-disponible).
Voluta ocellata Gmelin, 1791.
Buccinum cribrarium Lamarck, 1822.
Columbella guttata Sowerby, 1832.
Buccinum canariense Orbigny, 1839.

Matériel type: Non examiné.
Autre matériel examiné: CJP: Sta. 2: 6 spm, 2 coq; Sta. 7: 1 spm, 2 coq. CFB: Sta. 4: 3 coq; Sta. 6: 1 spm; Sta. 7: 5 coq.
Localité type: Non définie par Gmelin. Définition subséquente: Nassau, New Providence Island, Bahama Islands (RADWIN, 1978b).

Description: Coquille de taille modérée, 11-13 mm, fusiforme, protoconque à environ 2 tours, lisse; spire représentant les 3/5 de la hauteur totale de la coquille, aigue quand elle est entière (la coquille est habituellement étêtée), profil des tours plat, suture profonde; corps de la coquille cylindrique, ouverture modérément large, lèvre externe légèrement épaissie, dentelée sur sa face interne, columelle droite, lisse, canal siphonal trés court, canal anal peu marqué; absence de sculptures; décoration de points blancs sur fond noirâtre à brun-tabac foncé. Certaines formes possèdent une coquille entièrement jaune-blanc, d'autres une couleur de fond jaune ou brun pâle avec des points plus foncés; protoconque blanche à deux tours.

L'animal blanchâtre décoré de lignes croisillonées brun mordoré à rouge-brun sur l'ensemble du pied et de la tête, fondues en masse foncée sur le front et fragmentées en taches irrégulières sur l'avant du pied et sur le siphon, dont la partie distale porte un large anneau marron clair. Tour de l'œil et extrémité des tentacules blancs, base des tentacules brun-rouge, partie centrale des tentacules et sole brun léger. Extrémité du siphon faiblement moucheté de blanc cru. Opercule losangique, brunâtre subhyalin, portant des stries transversales sur une longueur et un petit éperon sur la longueur opposée.

Distribution: Zones tropicales et subtropicales de l'Atlantique, formes jumelles dans l'Indo-Pacifique.

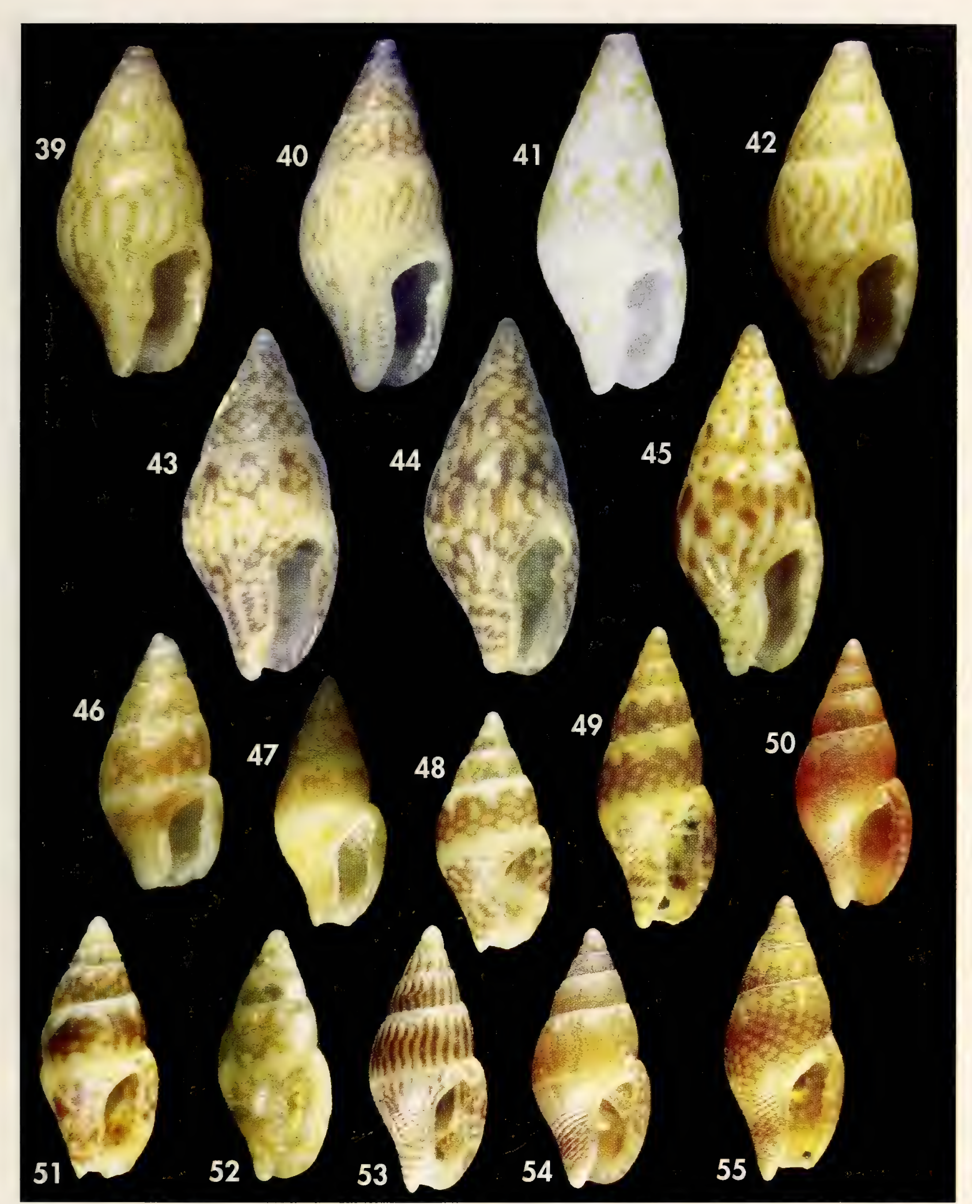
Remarques: *M. ocellata* n'est représentée autour de la Péninsule du Cap Vert que dans la zone littorale, sous blocs à très faible profondeur et généralement par des spécimens isolés ou en nombre très restreint. Les premiers tours sont le plus souvent absents chez les sujets adultes.

Mitrella psilla (Duclos, 1846) comb. nouv. (Figs. 6, 7, 46-55)

Columbella psilla Duclos, 1846.
Colombella japix Duclos, 1850.

Matériel type: 1 syntype de *C. psilla* (4.8 mm) au MNHN, désigné ici comme lectotype (Fig. 46). 1 syntype de *C. japix* (5.2 mm) (Fig. 47) au MNHN.
Autre matériel examiné: CJP: Sta. 2: 3 spm; Sta. 5: 9 spm, 7 coq; Sta. 6: 2 spm, 12 coq; Sta. 7: 1 spm; Sta. 8: 1spm; Sta. 9: 18 spm, 2 coq; Sta. 14: 9 spm; Sta. 15: 2 spm, 17 coq; Sta. 16: 2 spm, 1coq; Sta. 23: 33 spm, 1 coq; Sta. 25: 4 spm. CFB: Sta. 3: 5 coq; Sta. 4: 7 coq; Sta. 6: 2 spm, 1 coq; Sta. 7: 3 coq; Sta. 9: 1 spm, 4 coq; Sta. 14: 1 spm, 6 coq; Sta. 16: 3 spm; Sta. 17: 13 spm; Sta. 18: 2 coq; Sta. 22: 21 spm; Sta. 29: 11 coq.
Localité type: Inconnue. La Péninsule du Cap Vert, Centre Sénégal, est désignée ici comme localité type de *M. psilla* Duclos.

Description: Coquille de petite taille (de 4.8 à 6.2 mm), largeur égale ou légèrement inférieure à la moitié de la hauteur, dernier tour occupant environ 2/3 de la hauteur totale, suture bien marquée, tours sensiblement convexes et ré-



Figures 39-45. *Mitrella turbita*. 39: lectotype, 8.8 mm (MNHN); 40: paralectotype, 9.4 mm (MNHN); 41: syntype de *C. phylina*, 10 mm (MNHN); 42: syntype de *C. broderipi* var *lutea*, 8.75 mm (ZMB); 43-45: Petite Corniche, 8.3, 9.5 et 8 mm (CJP). Figures 46-55. *Mitrella psilla*. 46: lectotype, 4.8 mm (MNHN); 47: syntype de *C. japix*, 5.2 mm (MNHN); 48: Faillis, 4.8 mm (CJP); 49: Tiwa, 6.2 mm (CJP); 50: N'Gor, 5.9 mm (CJP); 51: Faillis, 5.0 mm (CJP); 52: Kunk Diabar, 4.9 mm (CJP); 53, 54: Faillis, 5.2 mm et 5.3 mm (CJP); 55: Le Tacoma, 5.7 mm (CJP).

Figures 39-45. Mitrella turbita. *39: lectotype, 8.8 mm (MNHN); 40: paralectotype, 9.4 mm (MNHN); 41: syntype of* C. phylina, *10 mm (MNHN); 42: syntype of* C. broderipi *var* lutea, *8.75 mm (ZMB); 43-45: Petite Corniche, 8.3, 9.5 and 8 mm (CJP). Figures 46-55.* Mitrella psilla. *46: lectotype, 4.8 mm (MNHN); 47: syntype of* C. japix, *5.2 mm (MNHN); 48: Faillis, 4.8 mm (CJP); 49: Tiwa, 6.2 mm (CJP); 50: N'Gor, 5.9 mm (CJP); 51: Faillis, 5.0 mm (CJP); 52: Kunk Diabar, 4.9 mm (CJP); 53, 54: Faillis, 5.2 mm and 5.3 mm (CJP); 55: Le Tacoma, 5.7 mm (CJP).*

gulièrement étagés; protoconque à environ 1 tour, bulbeuse, lisse, blanche avec quelquefois une bande de couleur médiane; sculpture constituée de faibles stries d'accroissement verticales visibles sous un fort grossissement, ainsi que d'une forte varice longitudinale positionnée sur le dernier tour, en retrait du bord labial; la columelle porte une dizaine de stries longitudinales; ouverture ovale, labre court et arqué, épaissi extérieurement et portant de 5 à 7 dents, cal columellaire transparent ne débordant pas de l'ouverture, portant quelques plis très peu marqués; décoration très variable, généralement constituée de taches rondes blanchâtres sur fond brun à marron plus ou moins foncé, parfois des alignements de taches se fondent en bandes blanches horizontales ou verticales, certaines coquilles possèdent une couleur paille à marron clair uniforme ou mouchetée de blanc (Figs. 48-55).

Animal blanchâtre tacheté de noirâtre sur l'ensemble du pied, le dessus de la sole et les bords latéraux sur le dessous. Les taches noirâtres peuvent devenir mauve ou lie-de-vin dans les zones périphériques ou inversement. Un large anneau noirâtre à mauve sur la partie centrale des tentacules, qui sont sensiblement spatulés à ce niveau, et un étroit anneau noirâtre à mauve vers l'extrémité du siphon. Moucheté de blanc cru à la pointe des tentacules, dans la partie antérieure du siphon, sur l'extrémité avant du pied et de la sole ainsi que sur la pointe arrière de la sole supérieure. Opercule jaune hyalin très léger, centre grisâtre flanqué d'un croissant latéral brun noirâtre clair à mi-distance du bord de l'opercule.

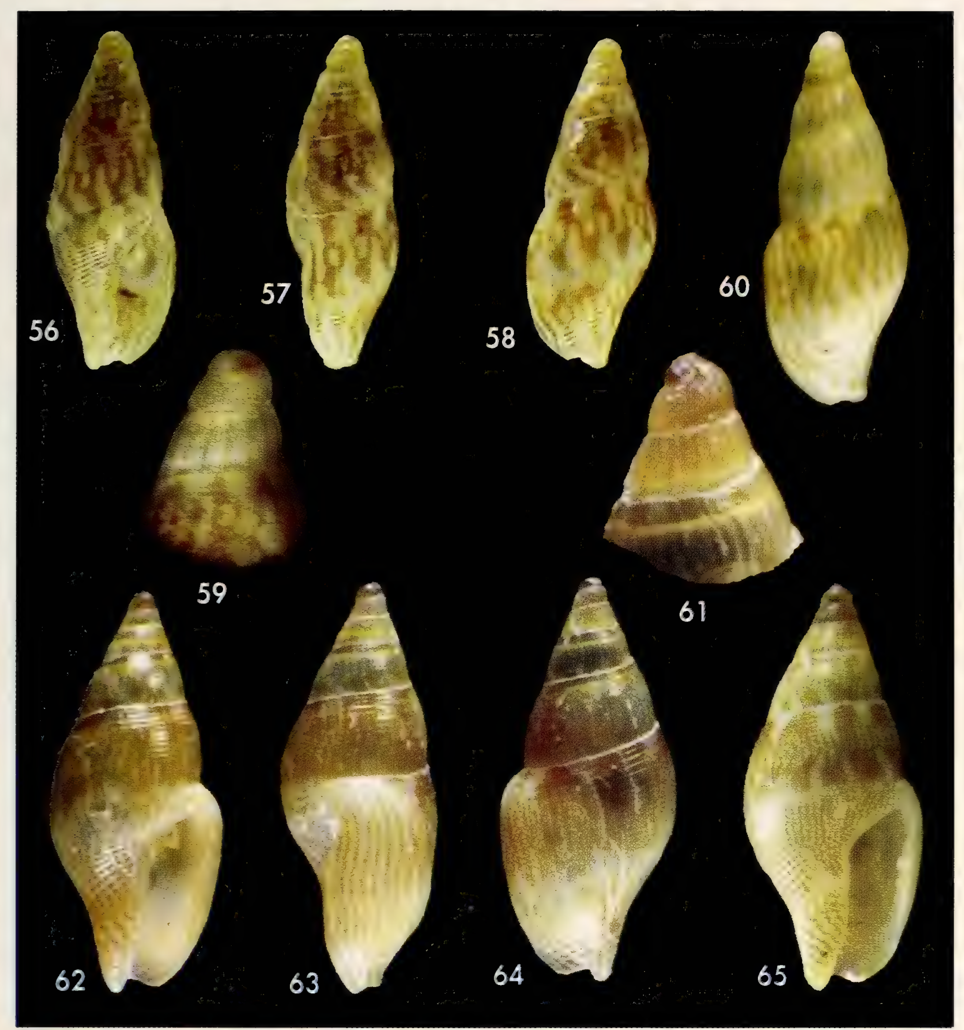
Distribution: L'espèce semble être distribuée du nord mauritanien au Sénégal et dans le sud angolais, sans solution de continuité dans le Golfe de Guinée. Il n'est pas exclu que les populations similaires d'Angola, dont les individus sont généralement plus grands que ceux du Sénégal, constituent une espèce jumelle de *M. psilla*, séparée de longue date des populations sénégalaises.

Remarques: *Mitrella psilla* constitue une espèce commune dans la région de Dakar, présente sur fonds durs dans la plupart des stations et à toutes les profondeurs de l'infralittoral. Les proportions et la décoration de la coquille varient de manière importante (Figs. 46-55), mais plusieurs traits morphologiques originaux et systématiquement corrélés (les tours convexes, le labre court et arqué et la varice située sur le dos en retrait du labre) permettent l'attribution spécifique avec certitude. Les sujets assimilables à *M. psilla* de Mauritanie et d'Angola présentent une homogénéité beaucoup plus grande quant à la morphologie et à la décoration de la coquille.

Mitrella turbita (Duclos, 1840) comb. nouv. (Figs. 2, 3, 39-45)

Buccinum 4. Le Rac: Adanson, 1757 (pré-Linnéen, non-disponible).
Colombella turbita Duclos, 1840.
Colombella phylina Duclos, 1846.
Columbella broderipi var. lutea V. Maltzan, 1884.
Columbella rac Dautzenberg, 1891.

Matériel type: 3 syntypes de *C. turbita* Duclos au MNHN: le mieux conservé d'entre eux (8.8 mm) est désigné ici comme lectotype (Fig. 39), les deux paralectotypes mesurent respectivement 9.4 mm (Fig. 40) et 10 mm. 2 syntypes de *C. phylina* Duclos (9 et 10 mm) (Fig. 41) au MNHN. 3 syntypes de *C. broderipi var lutea* V. Maltzan (2 adultes et 1 juvénile: 8.2 à 8.7 mm) au ZMN, Moll. 33327 (Fig. 42). 22 syntypes de *C.rac* Dautzenberg dans la Collection Adanson (MNHN). Les syntypes de *C. rac* (IRSNB, Collection Dautzenberg, ex-Chevreux) sur lesquels Dautzenberg a fondé sa description n'ont pas été examinés.
Autre matériel examiné: MNHN (Collection Adanson): 22 coq accompagnées du label: « 2,483, Buccin autre Rak... ». CJP: Sta. 2: 5 spm; Sta. 5: 1 coq; Sta. 6: 8 spm, 17 coq; Sta. 7: 3 spm, 1 coq; Sta.



Figures 56-60. *Mitrella fimbriata* sp. nov. 56-59: holotype, 5.1 mm, Le Tacoma (MNHN); 60: Le Tacoma, 5.8 mm (CJP). Figures 61-65. *Mitrella inflata* sp. nov. 61-64: holotype, 6.4 mm, Kunk Diabar (MNHN); 65: paratype, Kunk Diabar, 6.4 mm (CJP).

Figures 56-60. Mitrella fimbriata *sp. nov. 56-59: holotype, 5.1 mm, Le Tacoma (MNHN); 60: Le Tacoma, 5.8 mm (CJP). Figures 61-65.* Mitrella inflata *sp. nov. 61-64: holotype, 6.4 mm, Kunk Diabar (MNHN); 65: paratype, Kunk Diabar, 6.4 mm (CJP).*

8: 13 spm, 29 coq; Sta. 14: 46 spm, 4 coq; Sta. 15: 2 spm; Sta. 16: 2 spm; Sta. 25: 3 coq. CFB: Sta. 3: 2 coq; Sta. 4: 7 coq; Sta. 6: 2 spm, 43 coq; Sta. 7: 29 spm; Sta. 9: 2 spm, 9 coq; Sta. 13: 2 spm; Sta. 14: 390 spm; Sta. 18: 75 spm, 4 coq; Sta. 19: 1 spm; Sta. 22: 57 spm; Sta. 26: 6 coq.
Localité type: Inconnue. La Péninsule du Cap Vert, Centre Sénégal, est désignée ici comme localité type de *M. turbita* Duclos.

Description: Coquille de taille moyenne, 8 à 10 mm, largeur égale à environ 42 % de la hauteur, dernier tour occupant environ $^2/_3$ de la hauteur totale, suture bien marquée, tours pratiquement plans et régulièrement étagés; proto-

conque présentant environ 1.5 tour, bulbeuse, lisse, blanchâtre avec le sommet souvent violet; sculpture constituée de fortes côtes axiales, espacées, généralement sinueuses et centrées sur la zone médiane du dernier tour; 8 stries transverses à la base du dernier tour; ouverture ovale, 4 à 5 dents labiales, sinus anal supérieur assez marqué, cal columellaire opaque bien délimité, ne dépassant pas l'ouverture et portant 6 plis; décoration variable, constituée de taches blanches irrégulières sur fond marron (Figs. 43-45).

Animal blanchâtre à beige décoré de flammules longitudinales brun-orange léger à noirâtre, souvent fragmentées en petites taches régulières sur l'ensemble du pied, parfois plus foncées vers la tête et sur le siphon. Tentacules épais, portant un anneau ou un groupe de lignes longitudinales brun ou noirâtre dans leur partie intermédiaire, parfois mouchetés de blanc cru à leur extrémité. Siphon portant un anneau foncé assez étroit dans sa partie distale et moucheté de blanc cru sur toute sa moitié antérieure. Dessus de la sole portant de larges plages noirâtres, dessous de la sole blanc. Opercule subtriangulaire, faiblement arrondi, jaune moyen, avec zone d'attachement centrale large et noirâtre aux contours irréguliers et avec une ligne noirâtre longeant le bord postérieur.

Distribution: Connue des Canaries orientales jusqu'au Centre Sénégal (HERNÁNDEZ ET BOYER, 2005).

Remarques: Malgré les caractères passablement ambigus des figures type de DUCLOS (1840, 1846) (Figs. 2, 3), le matériel type de *C. turbita* (Figs. 39, 40) et celui de *C. phylina* (Fig. 41) ne laissent aucun doute quant à la prévalence de ces taxa sur la *Columbella rac* de DAUTZENBERG (1891), nom plus récent et toujours utilisé depuis pour désigner l'espèce. L'utilisation du taxon *C. rac* dans la littérature n'a pas été assez fréquemment réitérée pour autoriser une inversion de la précédence (article 23.9.1 du Code de Nomenclature Zoologique) et le nom plus ancien de *C. turbita* Duclos, 1840 doit prévaloir pour désigner l'espèce. Le matériel type de Dautzenberg, constitué par un lot confié par Mr Chevreux et déposé à l'IRSNB, n'a pu être examiné, mais la description et la figure type de *Columbella rac* (DAUTZENBERG, 1891: 38-40, figs. 2 a-c) ne laissent aucun doute sur la synonymie de ce taxon avec *C. turbita*. Le lot de 22 coquilles étiqueté « 2,483 Buccin autre Rak... » dans la Collection Adanson et reconnu par FISCHER-PIETTE (1942) est conspécifique de *C. turbita* et confirme l'interprétation faite par DAUTZENBERG (1891) du Rac d'Adanson à partir « d'une figuration médiocre et d'une diagnose trop courte ».

C. turbita, représentée sur fonds durs à tous les niveaux de l'infralittoral, apparait comme le plus commun des Columbellidae de la Péninsule du Cap Vert. Malgré la variabilité importante de la morphologie, de la taille et de la décoration de sa coquille (Figs. 39-45), l'espèce se distingue aisément des autres espèces de Columbellidae représentées dans l'Ouest Africain.

Mitrella fimbriata sp. nov. (Figs. 56-60)

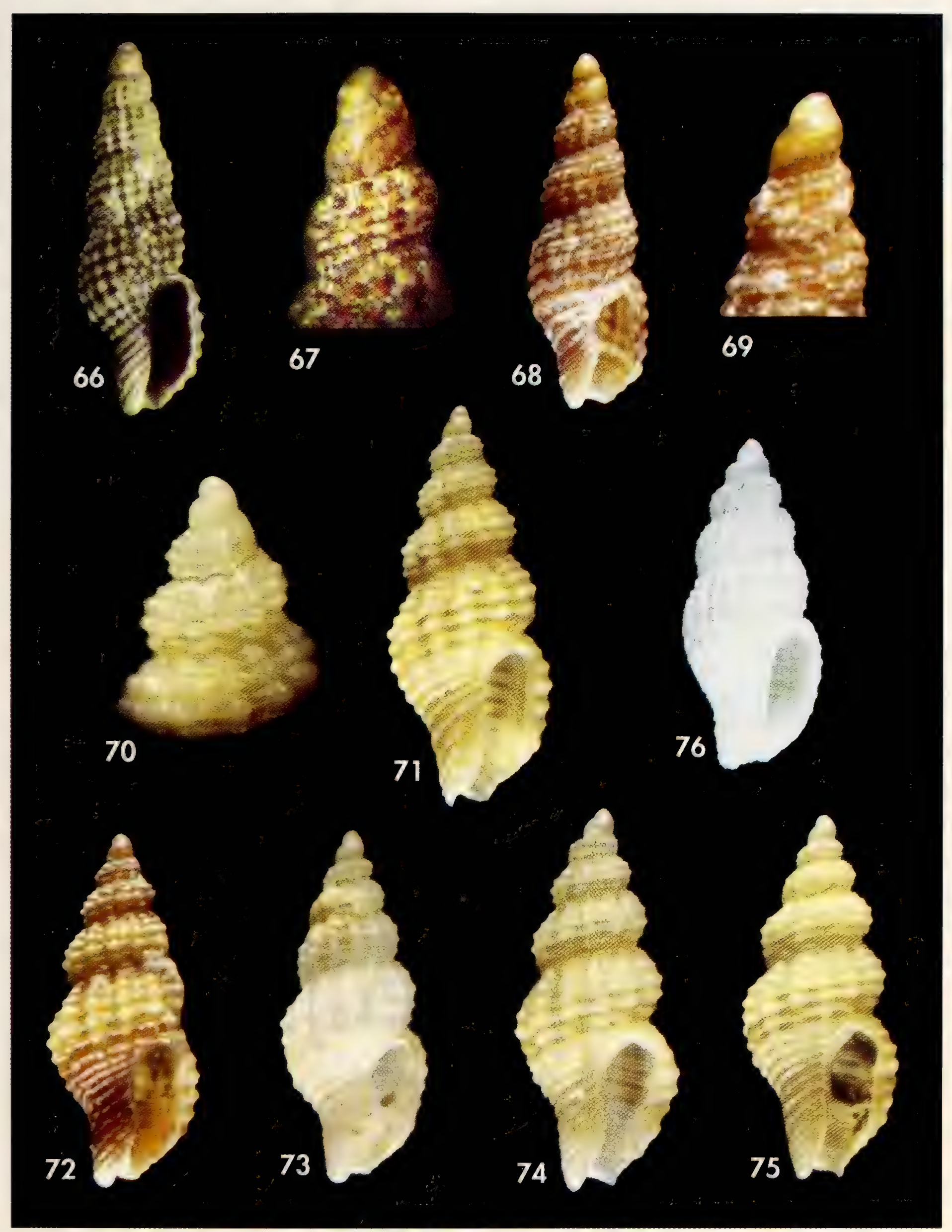
Matériel type: Holotype (5.1 x 2.0 mm) MNHN (Figs. 56-59), 17 paratypes déposés comme suit: 1 paratype (spm) MNHN, MHNG, MNCN, ZMK, ZMB, CER; 5 paratypes (1 spm, 2 coq et 2 juvéniles) CFB, 6 paratypes (1 spm, 3 coq et 2 juvéniles) CJP (Fig. 60), tous de la localité type.

Autre matériel examiné: CJP: Sta. 6: 5 spm, 4 coq; Sta. 7: 1 coq; Sta. 8: 9 spm, 2 coq; Sta. 9: 3 spm, 3 coq; Sta. 15: 9 coq; Sta. 16: 1 spm; Sta. 21: 2 coq; Sta. 23: 2 spm, 5 coq. CFB: Sta. 9: 5 spm, 4 coq; Sta. 14: 1 spm, 4 coq; Sta. 26: 6 coq; Sta. 28: 1 spm; Sta. 29: 4 spm.

Localité type: Le Tacoma, 5-13 m, à l'est de l'île de Gorée, Centre Sénégal.

Etymologie: Du latin *fimbriatus* (féminin: *-a*), orné d'une frange, en référence à la décoration subsuturale de la coquille.

Description: Coquille de petite taille (L = 4.8 à 5.8 mm), largeur égale ou légèrement inférieure à 40 % de la hauteur, dernier tour occupant environ $^{2}/_{3}$ de la



Figures 66-69. *Nassarina procera* sp. nov. 66, 67: holotype, 4.3 mm, Les Madeleines, Dakar (MNHN); 68, 69: paratype, environs de Dakar, 4.1 mm (CJP). Figures 70-75. *Nassarina rolani* sp. nov. 70, 71: holotype, 4.8 mm, Grand Thiouriba, Dakar (MNHN); 72-75: paratypes, 4.2, 4.2, 4.5 et 4.3 mm, Grand Thiouriba, Dakar (CJP). Figure 76. *Clathurella polignaci*, holotype, 4 mm, îles Bissagos (MNHN).

Figures 66-69. Nassarina procera *sp. nov. 66, 67: holotype, 4.3 mm, Les Madeleines, Dakar (MNHN); 68, 69: paratype, near Dakar, 4.1 mm (CJP). Figures 70-75.* Nassarina rolani *sp. nov. 70, 71: holotype, 4.8 mm, Grand Thiouriba, Dakar (MNHN); 72-75: paratypes, 4.2, 4.2, 4.5 and 4.3 mm, Grand Thiouriba, Dakar (CJP). Figure 76.* Clathurella polignaci, *holotype, 4 mm, îles Bissagos (MNHN).*

hauteur totale, suture incisée bien marquée, tours légèrement convexes et régulièrement étagés; protoconque à environ 0.75 tour, bulbeuse, lisse, blanche; sculpture constituée de faibles stries d'accroissement visibles sous fort grossissement, cordons spiraux régulièrement espacés, plus prononcés à la base du dernier tour, moins marqués dans la zone subsuturale et très effacés vers la base des tours de spire et vers le milieu du dernier tour; ouverture ovale, canal anal très légèrement marqué, canal siphonal court et profond, sur les spécimens matures le labre épaissi extérieurement porte 9 dents, cal columellaire transparent ne dépassant pas l'ouverture et portant 2 plis très peu marqués; décoration peu variable de lignes axiales sinusoïdes marron sur fond beige clair se rejoignant par 2 ou 3 sous la suture ainsi que de part et d'autre d'une lacune spirale au milieu du dernier tour pour former un système de franges; coquille translucide et fausse suture nettement visible par transparence.

Animal blanchâtre à jaune-crème décoré de taches vert-olive à brun foncé, de densité et de forme variables, parfois étroites et allongées. Opercule non-observé.

Distribution: Connue uniquement de la Péninsule du Cap Vert, Centre Sénégal.

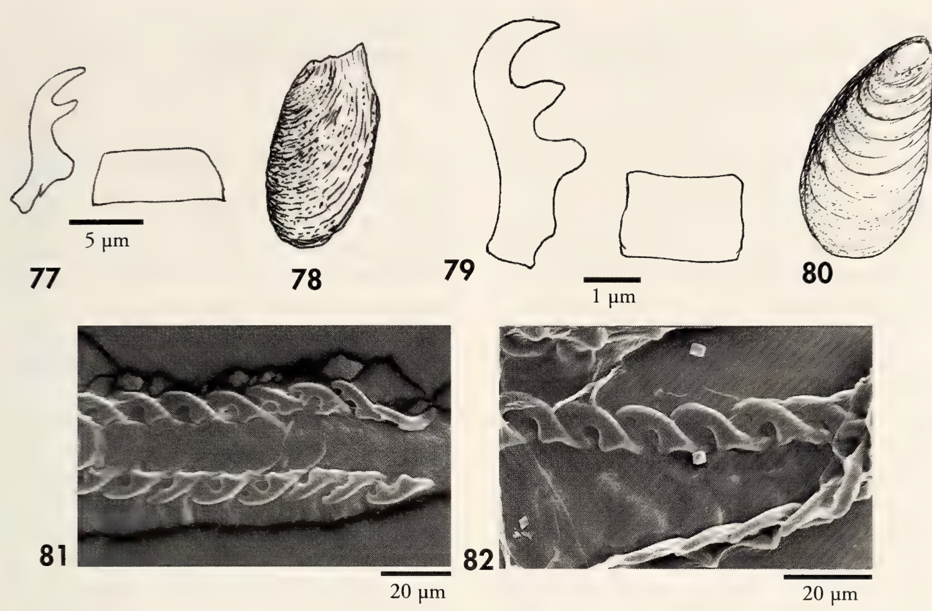
Remarques: *Mitrella fimbriata* sp. nov., assez commune localement, est bien représentée entre 5 et 40 m dans la zone prospectée. Les caractères morphologiques et la décoration de la coquille sont tout à fait originaux pour l'Afrique de l'Ouest et pour les eaux atlantiques. On attribue à sa moindre densité et à sa distribution plus irrégulière, ainsi qu'à son absence dans les petits fonds de la zone littorale, le fait qu'une espèce aussi originale n'ait pas été découverte et décrite préalablement d'un secteur particulièrement étudié de la province Ouest Africaine.

Mitrella inflata sp. nov. (Figs. 61-65)

Matériel type: Holotype (6.4 x 2.7mm) MNHN (Figs. 61-64), 5 paratypes déposés comme suit: 1 MNCN, 1 CFB, 1 CER, 2 CJP (Fig. 65), tous de la localité type.
Autre matériel examiné: CJP: Sta. 9: 1 spm; Sta. 15: 8 coq; Sta. 21: 13 spm. CFB: Sta. 6: 2 spm; Sta. 14: 2 spm; Sta. 18: 5 spm; Sta. 19: 14 spm; Sta. 21: 16 spm; Sta. 22: 23 spm.
Localité type: Haut fond du Kunk Diabar, 30-45 m, au large de la Petite Côte, Centre Sénégal.
Etymologie: Du latin *inflatus* (féminin: *-a*), enflé, gonflé, en référence à la forme dilatée de la coquille.

Description: Coquille de petite taille (5.8 à 6.8 mm), largeur légèrement inférieure à la moitié de la hauteur, dernier tour occupant environ 70 % de la hauteur totale, suture incisée bien marquée, tours légèrement convexes et régulièrement étagés; la protoconque à environ 1.5 tour, bulbeuse, lisse, blanche au sommet violet; la sculpture est constituée de faibles stries d'accroissement visibles sous fort grossissement et de cordons spiraux régulièrement espacés sur l'ensemble de la téléoconque, partiellement ou totalement effacés au milieu du dernier tour et vers la base des tours de spire; ouverture ovale, canal anal bien marqué, séparé en deux par une dent assez forte, canal siphonal court et profond, labre épaissi extérieurement portant 5 petites dents, cal columellaire transparent ne dépassant pas l'ouverture et portant 8 plis de très petite taille; décoration de lignes axiales sinusoïdes marron sur fond blanchâtre, se rejoignant par groupes de 4 à 7 sous la suture ainsi que de part et d'autre d'une lacune spirale vers le milieu du dernier tour, pour former un système de franges; coquille subtranslucide, fausse suture modérément distincte par transparence.

Animal blanchâtre décoré de petites taches brun-rouge clair sur la tête et le pied. Arête dorsale, liste arrière du pied et siphon tachés de brun foncé plus mat, extrémité du siphon portant parfois un anneau brun foncé, tentacules blanchâtres portant une tâche brun-rouge clair dans sa partie médiane, liseré marron clair sur le bord du pied, dessus de la sole blanc légèrement moucheté de blanc cru vers



Figures 77, 78. *Nassarina procera* sp. nov. 77: radula dent latérale et centrale; 78: opercule, longueur réelle 0,8 mm. Figures 79-82. *Nassarina rolani* sp. nov. 79: radula dent latérale et centrale; 80: opercule, longueur réelle 0,6 mm; 81, 82: radula.

Figures 77, 78. Nassarina procera *sp. nov. 77: lateral and central radular teeth; 78: opercule, real lenght 0,8 mm. Figures 79-82.* Nassarina rolani *sp. nov. 79: latearal and central radular teeth; 80: opercule, real lenght 0,6 mm; 81, 82: radula.*

l'extrémité postérieure, dessous blanc. Opercule subtriangulaire, jaunâtre, parfois finement moucheté de noir, zone d'attachement noire, étirée sur l'axe médian dans le sens longitudinal et superposée à la liste foncée du metapodium.

Distribution: Connue uniquement de la Péninsule du Cap Vert et au large de la Petite Côte, Centre Sénégal.

Remarques: *M. inflata* sp. nov. présente le même modèle de distribution que *M. fimbriata*, avec laquelle elle partage des systèmes de microsculpture et de décoration de la coquille très semblables. *M. inflata* se distingue de *M. fimbriata* par une taille supérieure et une silhouette plus renflée, une protoconque plus élancée au sommet violet, une téléoconque aux tours plus convexes et une décoration constituée de lignes axiales plus nombreuses et proportionnellement plus étroites. Ces 2 espèces peuvent être considérées comme étroitement apparentées et comme constituant un groupe d'espèces isolé dans le contexte atlantique.

Genre *Nassarina* Dall, 1889

Espèce type par désignation originale; *Nassarina bushii* Dall, 1889

Nassarina procera sp. nov. (Figs. 66-69, 77, 78)

Matériel type: Holotype (adulte: 4.3 x 1.4 mm) MNHN (Figs. 66, 67), 3 paratypes juvéniles (3.2 mm, 3.2 mm et 2.9 mm) de la localité type (CFB), 1 paratype adulte (4,1.mm) (Figs. 68, 69) des environs de Dakar (CJP).

Localité type: Iles des Madeleines, 7-20 m, à l'ouest de Dakar, Centre Sénégal.
Etymologie: Du latin *procerus* (féminin: *-a*), allongé, élancé, svelte, par référence à la silhouette étroite et effilée de la coquille.

Description: Coquille de petite taille (4.1 à 4.3 mm), allongée, cylindrique, largeur égale à environ $^{1}/_{3}$ de la hauteur, dernier tour occupant environ 60 % de la hauteur totale, suture incisée bien marquée, tours convexes; la protoconque à environ 1.75 tour, pointue, lisse, marron très clair avec trois bandes de couleur plus foncée; sculpture de la téléoconque constituée d'environ 17 fortes côtes axiales et de forts cordons spiraux d'épaisseur comparable, dont 5 au-dessus de l'ouverture et 8 au-dessous sur le dernier tour, donnant à la coquille un aspect réticulé avec des nodules aux intersections; ouverture rectangulaire, canal anal bien marqué, canal siphonal court et profond, labre externe épaissi extérieurement et portant 5 petites dents, cal columellaire transparent ne dépassant pas l'ouverture, sans dent visible; couleur uniforme marron avec quelques variations d'intensité sur la columelle et les côtes axiales.

Animal non-observé. Opercule corné avec noyau subapical (Fig. 78), radula composée sur chaque rang d'une dent centrale rectangulaire et de 2 dents latérales portant 2 cuspides effilées dans leur partie distale et 1 cuspide massive en forme de talon vers la base (Fig. 77).

Distribution: Connue uniquement par le matériel type de la Péninsule du Cap Vert, récolté sur fonds durs.

Remarques: *Nassarina procera* sp. nov. apparaît, aux côtés de *M. melvilli*, comme l'un des deux Columbellidae les plus rares de ceux récoltés dans l'infralittoral de la Péninsule du Cap Vert. Il paraît vraisemblable que *N. procera* se trouve là à la limite de sa distribution géographique ou que sa distribution bathymétrique principale se situe plutôt dans le domaine circalittoral.

Le placement de cette espèce dans le genre *Nassarina* est effectué sur la base des diagnoses proposées par RADWIN (1978a) et COSTA ET ABSALÃO (1998).

Nassarina rolani sp. nov. (Figs. 8, 70-75, 79-82)

Matériel type: Holotype (4.8 x 2.0 mm) (Figs. 70, 71) et 2 paratypes MNHN, 2 paratypes Z.M.B., 2 paratypes MNCN, 4 paratypes CER, 9 paratypes CFB, 10 paratypes CJP, tous de la localité type.
Autre matériel examiné: CJP: Sta. 6: 5 spm, 1 coq; Sta. 9: 90 spm, 16 coq; Sta. 14: 2 spm, 8 coq; Sta. 16: 16 spm, Sta. 20: 2spm, 3 coq; Sta. 21: 39 spm, 25 coq; Sta. 22: 6 spm, 2 coq; Sta. 25: 1 spm, 1 coq. CFB: Sta. 6: 10 spm, 10 coq; Sta. 9: 18 coq; Sta. 13: 2 spm; Sta. 14: 2 spm, 2 coq; Sta. 21: 1 coq; Sta. 22: 2 spm; Sta. 26: 4 spm; Sta. 27: 1 spm.
Localité type: Grand Thiouriba, sud-ouest de Dakar, 40 m, Péninsule du Cap Vert, Centre Sénégal.
Etymologie: L'espèce est dédiée au Dr. Emilio Rolán pour l'aide apportée tout au long de cette étude.

Description: Coquille de petite taille (4.2 à 5.3 mm), allongée, largeur égale à environ 40 % de la hauteur, dernier tour occupant environ 63 % de la hauteur totale, suture incisée bien marquée, tours bien convexes et régulièrement étagés; la protoconque de 1.75 à 2 tours, pointue, lisse, blanche; la sculpture de la téléoconque est constituée d'environ 11 fortes côtes axiales qui s'interrompent sur le dernier tour à la hauteur de l'ouverture, et de forts cordons spiraux, 6 au-dessus de l'ouverture et 10 à sa hauteur, les côtes sont plus épaisses que les cordons, qui tendent à chevaucher celles-ci; ouverture rectangulaire, canal anal faiblement marqué, canal siphonal court et profond, labre épaissi extérieurement et portant 5 dents, cal columellaire ne dépassant pas l'ouverture et portant 3 plis très faibles; couleur de fond variable depuis le blanc pur jusqu'au marron-violet foncé, avec bandes spirales plus foncées d'épaisseur variable (Figs. 72-75).

Décoration de l'animal très variable, le pied et la tête jusqu'à la base des ten-

tacules étant généralement marbrés de gris ou de noirâtre sur fond blanc à crème. Un anneau ou des marques longitudinales gris peuvent être présents sur la partie intermédiaire des tentacules. Chez les animaux sombres, le dessous de la sole blanche est couramment moucheté de noir, l'avant et l'arrière de la sole supérieure étant le plus souvent mouchetés de blanc cru. Parmi les autres modèles de décoration rencontrés figurent le fond uniforme blanc crème uniquement moucheté de blanc cru, le fond blanc moucheté de petits points blanc cru et de points et petites lignes ou coulures noirs, accompagné d'un siphon grisâtre moucheté de noir, ainsi le fond blanc orné d'une selle noire encerclant l'animal à la hauteur de la nuque.

Opercule jaune moyen, corné, avec noyau subapical (Fig. 80), radula composée sur chaque rang d'une dent centrale carrée et de 2 dents latérales portant 3 cuspides massives régulièrement distribuées et progressivement plus effilées vers la partie distale, ainsi qu' une faible saillie vers la base (Figs. 79, 81, 82).

Distribution: Connue uniquement des fonds durs de la Péninsule du Cap Vert, Centre Sénégal.

Remarques: L'extrême variabilité de *Nassarina rolani* sp. nov., rencontrée en populations localement nombreuses entre 10 et 40 m sur fonds durs, a donné lieu à des contrôles approfondis qui permettent de confirmer qu'aucun "groupe de forme" homogène ne peut être distingué à l'intérieur de la série, ni en ce qui concerne les proportions, la sculpture et la décoration de la coquille ni en ce qui concerne le chromatisme de l'animal ou la corrélation entre ces variables.

Clathurella polignaci Lamy, 1923 des îles Bissagos (Fig. 8: figure originale et Fig. 76: holotype MNHN) montre d'évidentes affinités avec *N. rolani*, dont elle se distingue principalement par une taille plus petite (4 mm), une protoconque plus courte, une silhouette plus pupoïde avec des tours de spire moins convexes et moins anguleux, des côtes et des cordons plus nombreux et moins épais.

Le replacement de *C. polignaci* dans le genre *Nassarina* est proposé ici. Ce genre, représenté par plusieurs espèces dans l'Atlantique occidental (Radwin, 1978a; Costa et Absalão, 1998), n'était reconnu jusqu'à présent dans l'Est Atlantique que par l'holotype de *N. polignaci* de Guinée-Bissau (jusqu'alors attribué à un autre genre) et par les 3 types de *N. rietae* Segers et Swinnen, 2004 de La Palma, Archipel des Canaries.

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Columbellidae (Gastropoda, Neogastropoda) of the gulf of Guinea with the description of eight new species

Columbellidae (Gastropoda, Neogastropoda) del Golfo de Guinea con la descripción de ocho especies nuevas

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ABSTRACT

The species of the family Columbellidae found in West Africa are studied. Five genera are represented: *Columbella* (1 species), *Anachis* (1), *Mitrella* (11), *Cotonopsis* (1) and *Strombina* (1). Of the 15 species mentioned, 8 are described as new. The genus *Strombina* is employed by first time for a West African species.

RESUMEN

Se estudian las especies de la familia Columbellidae encontradas en África occidental. Cinco géneros están representados en el área de estudio: *Columbella* (1 especie), *Anachis* (1), *Mitrella* (11), *Cotonopsis* (1) y *Strombina* (1). De las 15 especies mencionadas 8 se describen como nuevas para la ciencia. El género *Strombina* es empleado por vez primera para una especie oeste africana.

KEY WORDS: Columbellidae, *Columbella, Anachis, Mitrella, Cotonopsis, Strombina,* West Africa, Guinean Gulf, new species.

PALABRAS CLAVE: Columbellidae, *Columbella, Anachis, Mitrella, Cotonopsis, Strombina,* África occidental, golfo de Guinea, especies nuevas.

INTRODUCTION

The Columbellidae of the West Africa have been seldom studied in recent years. For most of the West African species, we can only find some descriptions and records in species lists, included in older works such those of DUCLOS (1835-40), MENKE (1853), MALTZAN (1884), MARTENS (1904), DAUTZENBERG AND FISCHER (1906), DAUTZENBERG (1910, 1927), FISCHER-PIETTE (1942a, b), NICKLÈS (1950) and KNUDSEN (1956).

More recently, isolated records have been mentioned for São Tomé, in FERNANDES AND ROLÁN (1993), and Angola, in GOFAS, PINTO AFONSO AND BRANDÃO (1985), with some new records in ROLÁN AND RYALL (1999a, b) and ROLAN AND TRIGO (2000); also for Gabon, in BERNARD (1984).

The Mediterranean species of the family have been revised in some recent papers: SCHIRÒ (1979), SABELLI AND SPADA (1981), LUQUE (1984), VAN AARTSEN, MENKHORST AND GITTENBERGER (1984), MIFSUD (2000), CHIARELLI, MICALI AND QUADRI (2003), GIANNUZZI-SAVELLI, PUSATERI, PALMERI AND EBREO (2003). The Canary Islands species are treated in NORDSIECK AND GARCÍA-TALAVERA (1979) and in HERNÁNDEZ AND BOYER (2005) and

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those from the Cape Verde Islands in the publications of BURNAY AND MONTEIRO (1977), COSEL (1982a, b, c), ROLÁN AND LUQUE (2002) and ROLÁN (2002, 2004). The Senegal species are revised by PELORCE AND BOYER (2005).

Columbellid classification is still problematic because of insufficient information for most species, lack of discrete characters useful for distinguishing species groups, conchological and radular variation within the family and the geographically restricted basis of the most frequently used columbellid classifications (PACE, 1902 and DEMAINTENON, 1999). This makes the generic placement of species difficult, and thus we tentatively use here *Anachis* (in the sense of RADWIN, 1977a, b, supported by the results of DEMAINTENON, 1999) and *Mitrella* (a polyphyletic genus according to DEMAINTENON, 1999), due to the resemblance of each of the new species with the type species of both genera.

In this paper, which complements the study of Dakar species by Pelorce and Boyer (this volume), we consider the Gulf of Guinea in a broad sense from south of Dakar to the south of Angola.

MATERIAL AND METHODS

Most the material studied is in the author's collection, constituted during many expeditions to West Africa and by diving, dredging, and sorting of sediment. Besides, material was loaned by the MNHN, some types by ZMUC, and other material was also studied from the private collections mentioned in Acknowledgements.

In order to standardize the criteria for character descriptions we follow DEMAINTENON (1999) for descriptions of operculum and radula.

The radular terminology is based on BANDEL (1984).

Abbreviations

AMNH American Museum of Natural History, New York.
BMNH The Natural History Museum, London.
MNCN Museo Nacional de Ciencias Naturales, Madrid.
MNHN Muséum National d'Histoire Naturelle, Paris.
SMF Senckenberg Museum, Frankfurt.
ZMUC Zoologisk Museum, Kobenhavn.
ZSM Zoologische Staatsammlung Muenchen, Munich.
CCS collection of C. Schroenherr, Luanda.
CER collection of E. Rolán, Vigo.
CFB collection of Franck Boyer, Sevran.
CJH collection of José María Hernández, Gran Canaria.
CJP collection of Jacques Pelorce, Le Grau du Roi.
CJT collection of Juan Trigo, A Coruña.
CHD collection of Juan Horro-Ana Delgado, Vigo.
CPH collection of Jean Paul Hattenberger, France.
sp: live collected specimen.
s: empty shell.
j: juvenile shell.
f: fragment of shell.

RESULTS

Genus *Columbella* Lamarck, 1799

Type species: *Voluta mercatoria* Linné, 1758. Recent, Caribbean. Designated by Lamarck, *Mém. Soc. Hist. Nat. Paris*: 70.

Columbella adansoni Menke, 1853 (Figs. 1-14, 149, 160)

Columbella adansoni Menke, 1853. *Zeitschr. Malakozool.*, 10 (5-6): 74-75. [Type locality: São Vicente Island, Cape Verde archipelago].
Columbella rufa Menke, 1853. *Zeitschr. Malakozool.*, 10 (5-6): 75.

Columbella rustica auct. non (Linnaeus, 1758).
Columbella spongiarium Duclos *sensu* ROCHEBRUNE (1881a).
Columbella rustica striata (Duclos) *sensu* PÉREZ SÁNCHEZ AND MORENO BATET (1991).

Type material: Lectotype, designated by MOOLENBEEK AND HOENSELAAR (1991), in SMF.
Other material examined: Many shells and specimens from Madeira; Canaries; Azores; Cape Verde Islands; Ghana; São Tomé; Angola.

Description: See NORDSIECK AND GARCÍA-TALAVERA (1979, as *Columbella rustica striata*). Shell (Figs. 1-11) solid, with a large and wide last whorl, and a conical pointed spire with 4-6 whorls.

Protoconch (Figs. 12-14) of several whorls. Colour of teleoconch very variable, pink, orange, brown, usually with blotches of several colours frequently with small oval light spots disposed spirally. Aperture elongate, straightened at the middle by an enlargement of the external lip.

Dimensions: Up to 21 mm, many populations composed by smaller specimens of about 8-12 mm only.

Soft parts pigmented but variable according to shell colour.

Radula (Fig. 149) with a central tooth four times as wide as long and with very acute posterior corners. Lateral teeth about three times as long as wide, with twisted base; cutting edge of laterals with the basal cusp low and long, the central cusp wide and not sharpened, and the apical cusp acute and wide.

Operculum (Fig. 160) light brown, ovoid-elongate, with an ovoid mark of insertion with a small prominence in the middle.

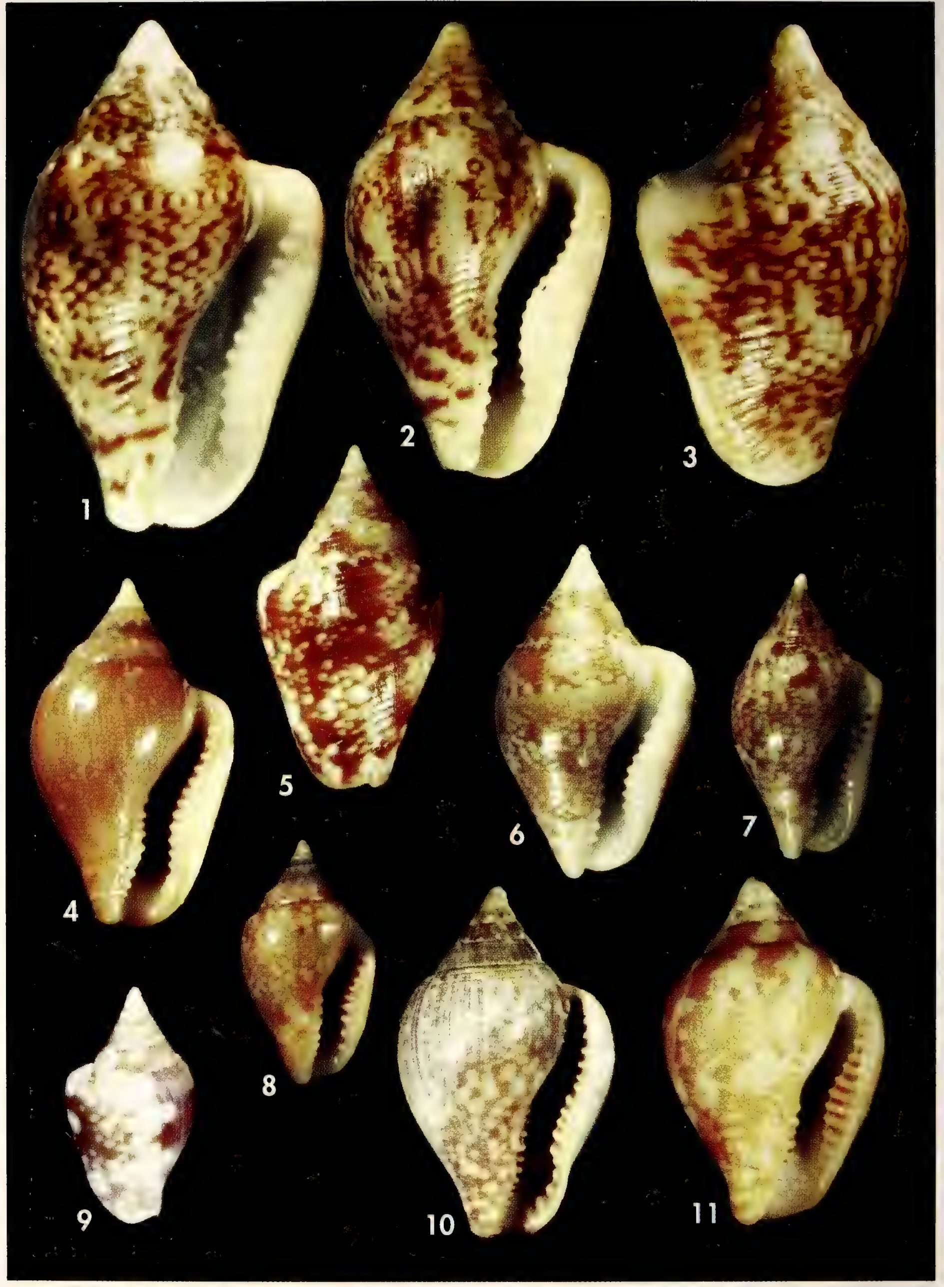
Distribution: The species is known from the Macaronesian archipelagos and the mainland West African coast from the Gulf of Guinea to Angola (ROLÁN AND RYALL, 1999a).

Remarks: In the Gulf of Guinea, the genus *Columbella* is represented by a single species, whose shells, of medium size, and abundant in shallow water areas. This species was confused until recently with *C. rustica* (Linné, 1758), so references to *C. rustica* for the area (NICKLÈS, 1950 or BERNARD, 1984, among others) must be considered to belong to *C. adansoni* Menke, 1853.

MOOLENBEEK AND HOENSELAAR (1992) established the differences between both species, based on protoconch and radula. These authors also explained the reasons for their distribution, on the basis of oceanic currents and interspecific competition. They concluded that the first, *Columbella adansoni*, is present in the Macaronesian archipelagos and the second, *Columbella rustica*, in the Mediterranean Sea and along the northern coast of West Africa. OLIVERIO (1995) confirmed these differences on allozyme based studies. ROLÁN AND RYALL (1999a) established the geographic range of distribution of both species along the African coast. In the present work the radula (Fig. 148) and operculum (Fig. 159) of *Columbella rustica* are illustrated to point out the differences.

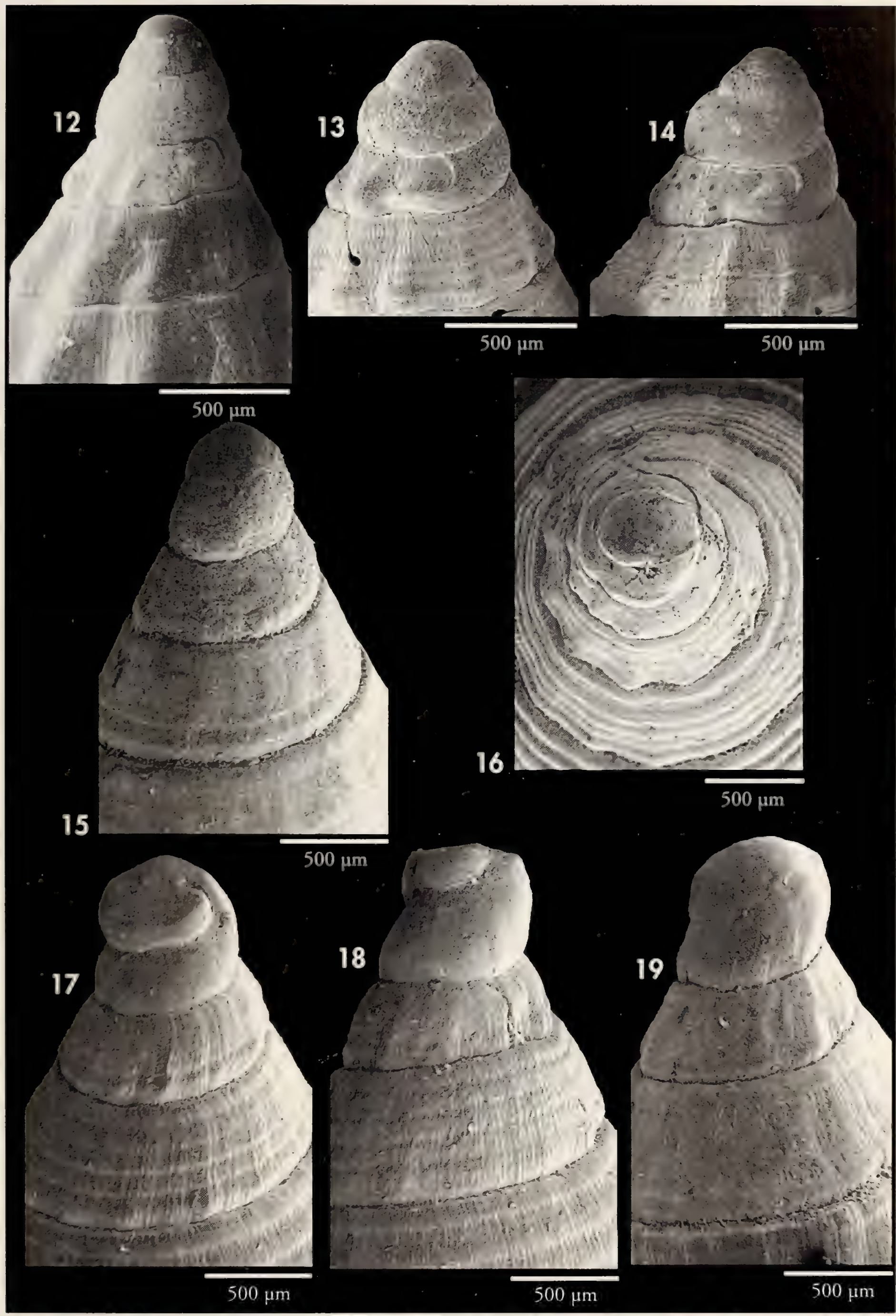
The reasons for the confusion between both species are due to the great intraspecific variability which is more important than the differential characters between the two species. Therefore, with the simple observation of the shells without protoconch is impossible to know to which taxon correspond and from where they come from. The protoconch of *C. rustica* is paucispiral (Figs. 15-19). The planktotrophic multispiral protoconch of *C. adansoni* supposes a pelagic larval development making feasible a distribution along archipelagos and main coast. *Columbella adansoni* has a larger larval dispersal ability ranging from from the Azores to South Angola, a geographical range of distribution greater than that of *C. rustica*.

C. adansoni is very variable in different habitats. One form has shells with a very prominent aperture, while another has very small one; the colour can be uniform or spotted. Sometimes the shells are minute, in other places double the size. In the Cape Verde archipelago, specimens of different size often live together.



Figures 1-11. *Columbella adansoni*. 1-3: shells, 20.7, 19.1, 19.1 mm, Lanzarote, Canary Is.; 4-6: shells, 14.6, 14.5, 13.4, mm, Mordeira, Sal, Cape Verde Islands; 7, 8: shells, 11.7, 10.0 mm, Sal Rei, Boavista, Cape Verde Islands; 9: shell, 10 mm, Praia Amelia, Angola; 10, 11: shells, 14.5, 14.4 mm, Luanda, Angola (all from CER).

Figuras 1-11. Columbella adansoni. *1-3: conchas, 20,7, 19,1, 19,1 mm, Lanzarote, Islas Canarias; 4-6: conchas, 14,6, 14,5, 13,4, mm, Mordeira, Sal, Islas de Cabo Verde; 7, 8: conchas, 11,7, 10,0 mm, Sal Rei, Boavista, Islas de Cabo Verde; 9: concha, 10 mm, Praia Amelia, Angola; 10, 11: conchas, 14,5, 14,4 mm, Luanda, Angola (todas de la CER).*



Figures 12-14. Protoconchs of *C. adansoni,* Cape Verde Islands. Figures 15-19. Protoconchs of *C. rustica.* 15, 16: L'Etoile, Nouadhibou, Mauritania; 17-19: Cullera, Valencia, Spain (all from CER). *Figuras 12-14. Protoconchas de* C. adansoni, *Islas de Cabo Verde. Figuras 15-19. Protoconchas de* C. rustica. *15, 16: L'Etoile, Nouadhibou, Mauritania; 17-19: Cullera, Valencia, España (todas de la CER).*

Genus *Anachis* H. Adams and A. Adams, 1853

Type species: *Columbella scalarina* G. B. Sowerby II, 1832, from Panama (Chiriquí), by subsequent designation (TATE, 1869).
Diagnosis: RADWIN (1977a, p. 120).

Anachis ryalli spec. nov. (Figs. 20-27)

Type material: Holotype (Fig. 20) in MNHN. Paratypes: AMNH (1, Fig. 21), MNCN (1, 15.05/46628, Fig. 22), BMNH (1, Fig. 23), ZSM (1, Fig. 24), CJP (3), CJH (3), CFB (6), CER (5), CPR (137), all from the type locality.
Type locality: Off Sekondi, Ghana, trawled around 40 m.
Etymology: The species is named after Peter Ryall, malacologist who lived for many years in Ghana and collected the type material.

Description: Shell solid (Figs. 20-24), up to 8.3 mm in length, broadly fusiform with a moderately high spire.

Protoconch (Figs. 26, 27) of 1 $^{1}/_{4}$ whorls, sharply pointed, and about 500 µm in maximum diameter, smooth and usually whitish in colour but cream on the upper part.

Teleoconch of 4-4 $^{1}/_{2}$ hardly convex spiral whorls, with distinct suture and small subsutural shelf. Sculpture formed by axial ribs, well defined subsuturally, between 18 and 22 on the last whorl. Many spiral threads visible only in the interspaces of the ribs, but more evident near the base, where the axial ribs disappear.

Aperture narrow and axially elongate, usually white inside. Columella curved, S-shaped, with 5-6 small denticles in the lower part, the uppermost being the most prominent. Inner part of external lip with about 7-8 denticles, the second one larger than the others.

Shell colour uniformly cream or whitish. Periostracum thin, smooth and transparent.

Soft parts, operculum and radula unknown.

Distribution: Only known from the type material, from Ghana.

Remarks: *A. ryalli* most resembles the Senegalese species *A. aurantia* (Lamarck, 1822) (= *A. cancellata* Gaskoin, 1851) but the latter is larger, with a wider and darker shell. Also it may be differentiated from *A. freytagi* Maltzan, 1884 [= *Columbella* (*Anachis*) *bubakensis* Lamy, 1923], from Senegal and Bissagos Islands, because its shell is smaller and narrower, uniformly subhyaline, light tan colour or brownish, with a narrow aperture and a contracted base. Even samples of *A. freytagi* with lighter colour and almost erased colour pattern, retain the typical colour in the first whorls and have a more rectilinear profile.

Anachis cuspidata Marrat, 1877 (= *A. emergens* Fischer and Nicklès, 1946), from Senegal, is wider and has a more colourful shell.

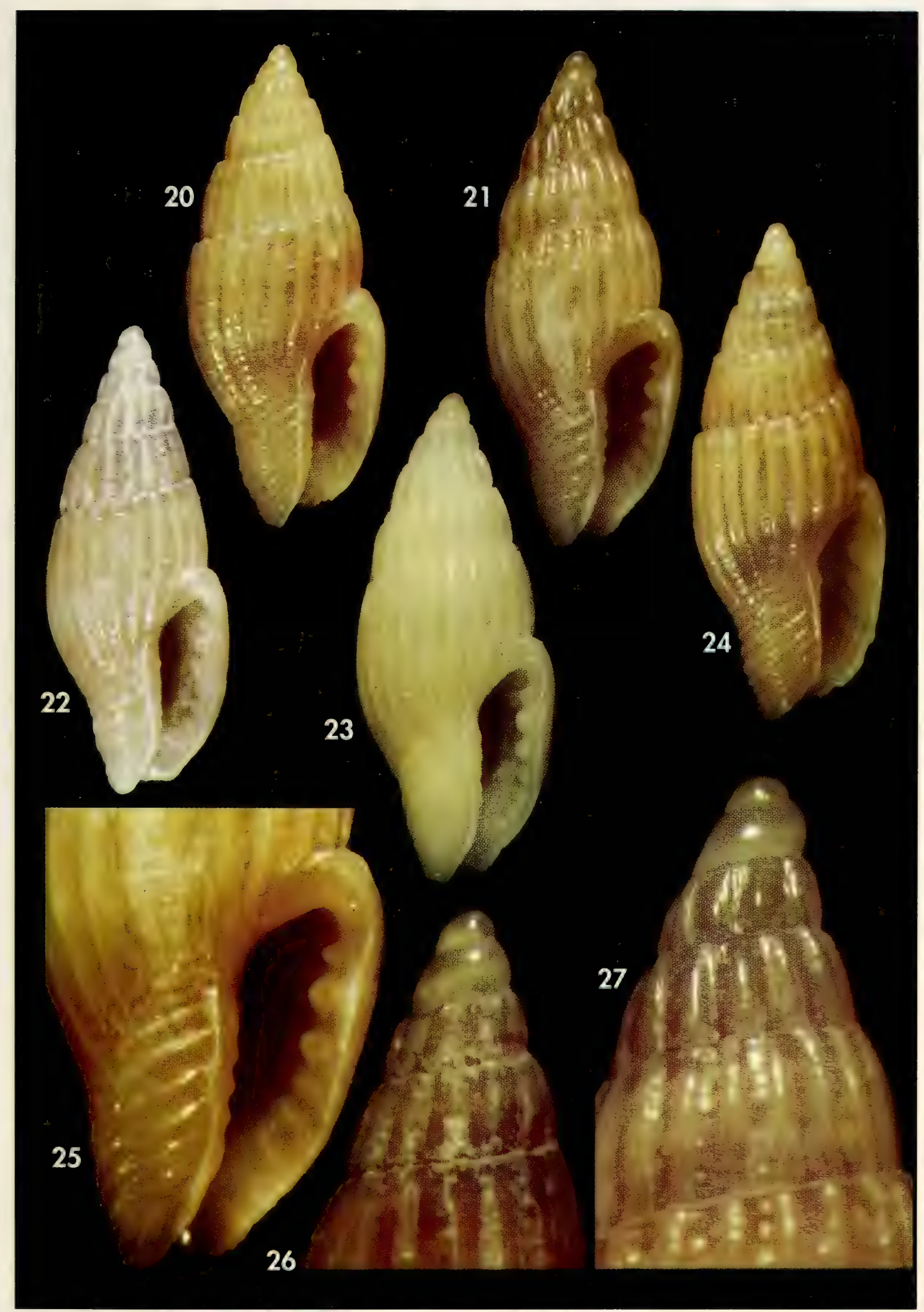
Anachis turbita (Duclos, 1840) (= *rac* Dautzenberg, 1891), from Senegal and Canary Islands, is more colourful, has a wider shell and its protoconch is not so pointed.

Anachis ryalli may be differentiated from *A. valledori* Rolán and Luque, 1999, from the Cape Verde Islands, because the latter species has a smaller and narrower shell, is uniformly light in colour without brown axial lines, has a narrow aperture, and the protoconch is evidently more elevated and whitish.

Anachis avaroides Nordsieck, 1975, from the Canary and Selvagens Islands, is wider, has constant colouration of axial bands and ocelli, and lacks spiral sculpture, except at the base.

Genus *Mitrella* Risso, 1826

Type species: *Murex scriptus* Linnaeus, 1758 (= *Mitrella flaminea* Risso, 1826), by subsequent designation of MÖRCH (1859).



Figures 20-27. *Anachis ryalli* spec. nov. 20: holotype, 6.2 mm; 21-24: paratypes, 6.5 (AMNH), 6.0 (MNCN), 6.4 (BMNH) and 6.7 mm (ZSM), Sekondi, Ghana, 40 m. 25: detail of the aperture; 26, 27: detail of the protoconch of paratypes of Figures 21 and 24.

Figuras 20-27. Anachis ryalli *spec. nov. 20: holotipo, 6,2 mm; 21-24: paratipos, 6,5 (AMNH), 6,0 (MNCN), 6,4 (BMNH) y 6,7 mm (ZSM), Sekondi, Ghana, 40 m. 25: detalle de la abertura; 26, 27: detalle de la protoconcha de los paratipos de las Figuras 21 y 24.*

Diagnosis: Radwin (1977b, p. 337), but see remarks of the same author and deMaintenon (1999, p. 267)

Mitrella pallaryi (Dautzenberg, 1927) (Figs. 28-34, 152, 163)

Columbella (Mitrella) vulpecula Pallary. 1900 ex Monterosato ms. *Coq. Mar. litt. Dép. d'Oran. J. Conchyl.*, 48(3): 279, pl. 6. fig. 8 (also var. *minor* Pallary and var. *albida* Pallary). [Type locality: Oran, Algeria].

Pyrene pallaryi Dautzenberg, 1927. nom. nov. pro *Columbella vulpecula* Pallary, 1900 non C. B. Sowerby, 1844. *Res. Camp. Sci. Albert I*, 72: 89.

Type material: Not examined.

Other material examined: Atlantic: Spain: Galicia: 75 sp, 10 s, several j, from numerous localities (CJT, CHD). Portugal: 4 sp, between Salema and Praia da Luz, Algarve, 37° 00′ N, 08° 45′ W, 70 m (MNHN); 1 s, N/O Faial, 37° 01.3′ N, 09° 05.7W, 135 m (MNHN). Mediterranean: Spain: Mar de Alborán, Almería: 30 sp and s, 100-130 m (CER); 16 sp, Almería Bay (CER); Málaga: 4 sp, Marbella, 50 m (CER). Algeria: 5 s, near Orán, diving, 10 m (CER); 5 s, Orán, (MNHN). Malta: 6 s, 40 m (CER). Morocco: 6 s, Tangiers, expiscis *Lepidotrigla* (MNHN); 3 sp, dredgings, 60-100 m (CER). Sahara: 25 sp, and s (CER). Azores archipelago: 2 c, 37° 03′ N, 25° 09′ W, N Santa Maria, 110 m (MNHN); 1 s, 38° 03′ 40″N, 30° 55′ W, 98 m (MNHN). Bay of Biscay: 2 s, 43° 46.51′ N, 02° 00.58′ W, 165 m (MNHN). Madeira: N/O "Jean Charcot ZARCO, St. 21, 33° 00.7′ N, 16° 25.5W, 220-290 m (MNHN). Canary Islands: 2 s, La Palma, nets, 100-150 m (CER); 4 sp, La Palma, nets, 100-200 m (MNHN); 40 sp, 5 s, Tasaente, La Palma, 150-200 m (CER); 1 s, Tenerife, 100-150 m (CER); 1 s, Gran Canaria (CER). Mauritania: continental plateau, 18° 18′ N, 16° 31′ W, 134 m (MNHN); 1 s, "N'Diago" Stn. 306, 19° 6′ N, 16° 40′ W, 93 m (MNHN). Senegal: 7 s, Gorée (CFS); 4 s, Cap Manuel, 50 m (MNHN); 3 s, Cap de Naza, 50 m (MNHN). Congo: 2 sp, Pointe Noire, Plage Mendame (CPH). Angola: 1 sp, 2 s, Ilha de Luanda, 75-90 m (MNHN); 2 sp, Luanda, 20 m (CCS); 4 s, Luanda, dragados, 60 m (CER); 1 sp, 1 s, Mussulo, Luanda, 90-100 m (MNHN); 10 s, Palmeirinhas (CER); 5 s, Saco Mar (CER).

Description: For shell description and colour pattern of the head-foot, protoconch and operculum, see Luque (1986: 236, pl. 2, figs. 9, 15). Shell (Figs. 28-33) elongate, solid, sharply pointed, smooth, shiny and with a curved profile of the whorls.

Protoconch (Fig. 34) of about three whorls, also illustrated with SEM in Rolán and Trigo (2000, figs. 6, 7).

Radula (Fig. 152, see also Luque, 1986, pl. 3, fig. g, and Rolán and Trigo, 2000, fig. 8), with a central tooth four times as wide as long and with acute posterior corners. Lateral teeth about four times as long as wide; with twisted base; cutting edge of laterals with the basal cusp short and prominent, and both central and apical cusps narrow and acute.

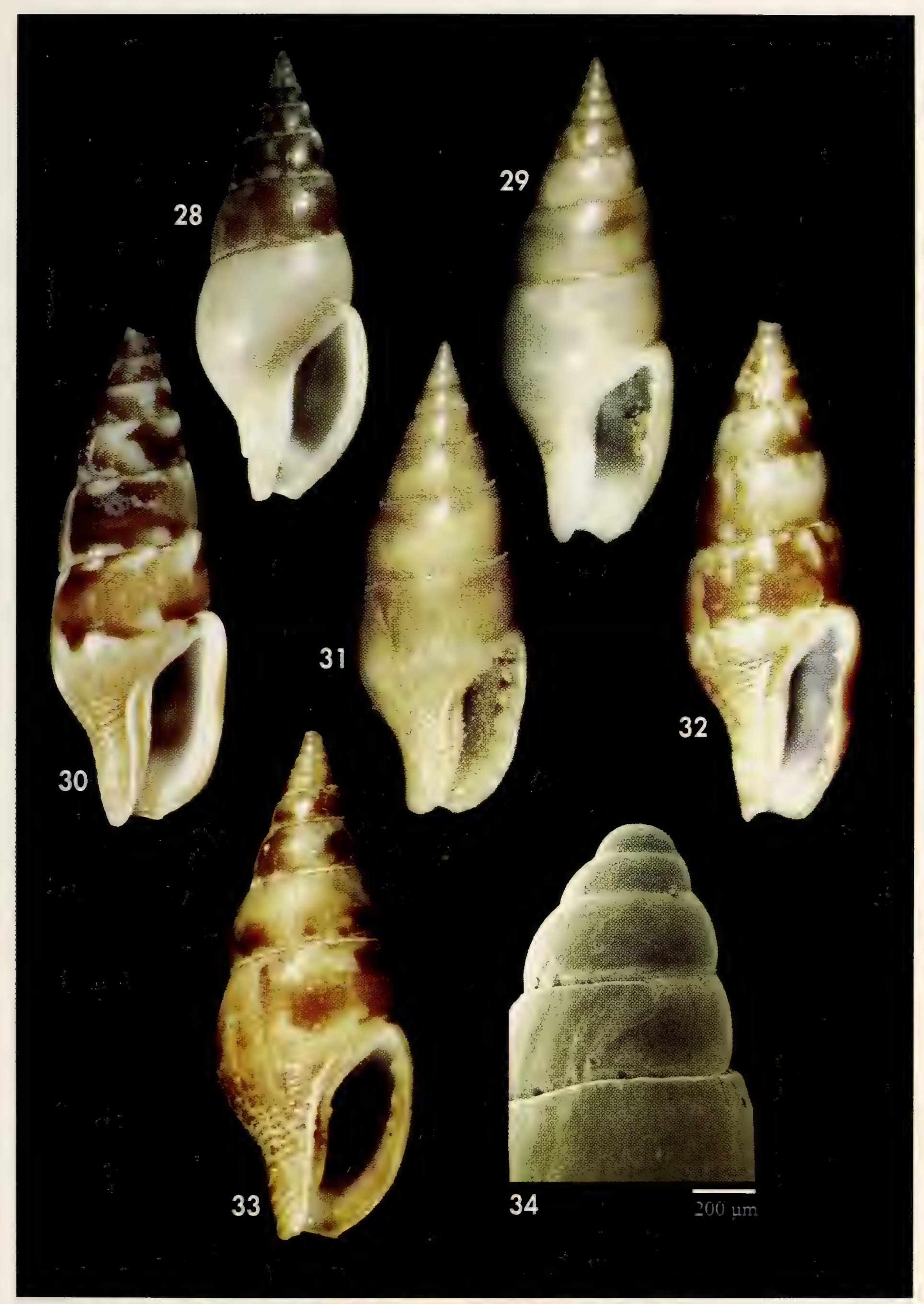
Operculum (Fig. 163) light brown, ovoid, almost circular with an ovoid mark of insertion, which is almost divided in two by an elongate prominence at the middle part.

Distribution: Described from the Mediterranean (Oran) by Pallary (1900, as *Columbella vulpecula*), also cited by Sabelli, Giannuzzi-Savelli and Bedulli (1990) and Chiarelli, 2002; in Europa by Bouchet, Le Renard and Gofas (2001), Dautzenberg (1927) recorded it from Azores, Pasteur-Humbert (1962) from Casablanca, Morocco, Nordsieck (1968) from Orán, and Schiró (1979) from Alboran Sea.

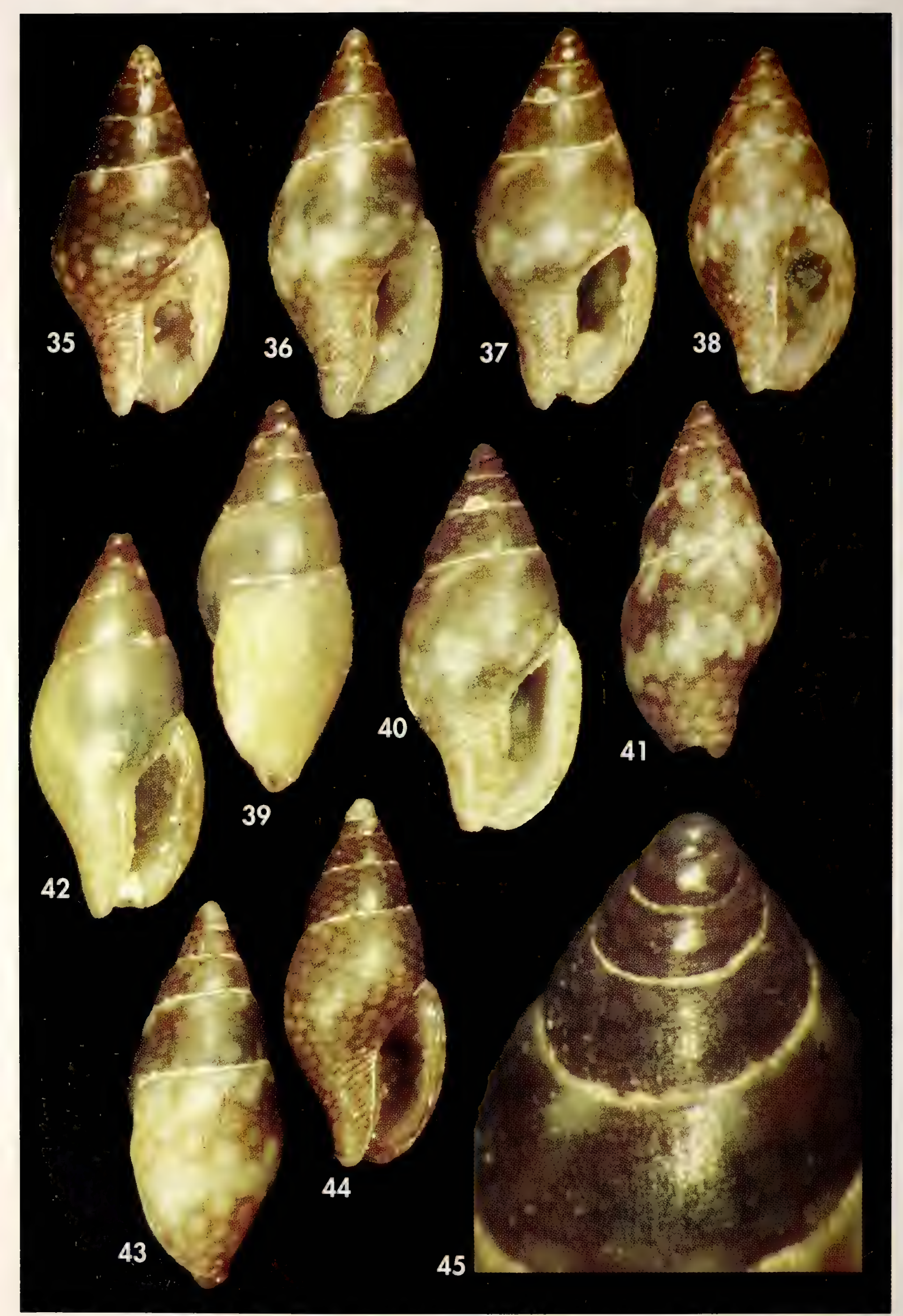
Macedo, Macedo and Borges (1999) also recorded it from Portugal. In Spain it has been found by Sierra, García and Lloríś (1978) and Sabelli and Spada (1981) from the Canaries, Gibraltar and other places in South Spain. Cecalupo and Giusti (1989) mention it for Capraia, at 400-440 m. Poppe and Goto (1991: 152, pl. 31, fig. 6) mention those records already known.

Rolán and Ryall (1999b) and Rolán and Trigo (2000) recorded it for Angola.

Mitrella pallaryi has a multispiral protoconch indicating planktotrophy. Its distribution area is large and includes the whole Mediterranean, the Atlantic

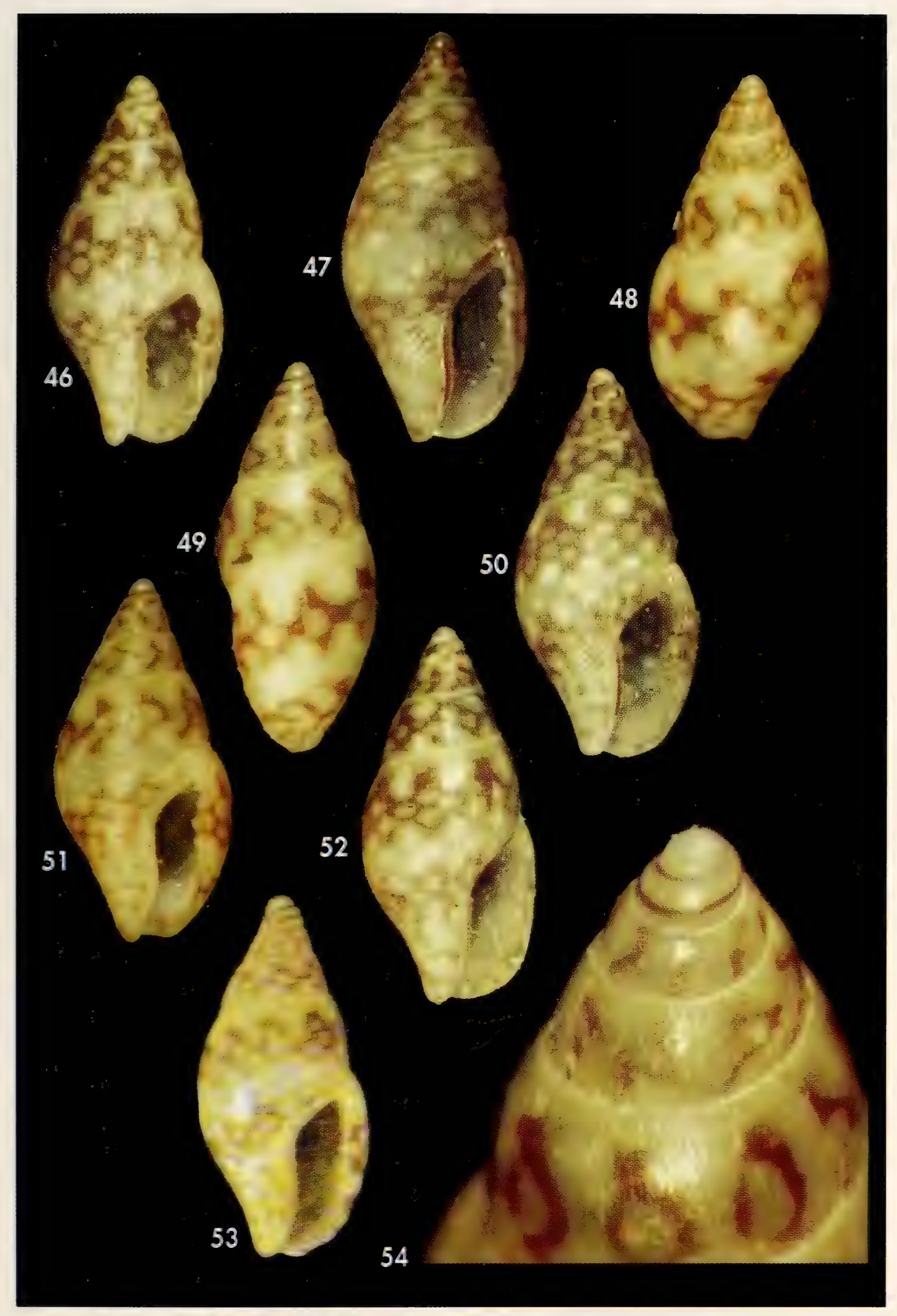


Figures 28-34. *Mitrella pallaryi.* 28, 29: 17.0, 14.5 mm, Camariñas, Galicia, Spain (CER); 30: 14.7 mm, Oran, Algeria (CER); 31: 16.1 mm, La Palma, Canary I. (CER); 32: 17.3 mm, Luanda, Angola (CER); 33: 15.5 mm, A Guarda, Galicia, Spain; 34: protoconch, Luanda, Angola.
Figuras 28-34. Mitrella pallaryi. *28, 29: 17,0, 14,5 mm, Camariñas, Galicia, España (CER); 30: 14,7 mm, Orán, Algeria (CER); 31: 16,1 mm, La Palma, Islas Canarias (CER); 32: 17,3 mm, Luanda, Angola (CER); 33: 15,5 mm, A Guarda, Galicia, España; 34: protoconcha, Luanda, Angola.*



Figures 35-45. *Mitrella psilla.* 35-44: shells, between 4.6 and 5.0 mm (CER). Baia de l'Etoile, Mauritania, intertidal; 45: protoconch.

Figuras 35-45. Mitrella psilla. *35-44: conchas, entre 4,6 y 5,0 mm (CER). Bahía de l'Etoile, Mauritania, intermareal; 45: protoconcha.*



Figures 46-54. *Mitrella psilla*. 46-52: shells, 4.7, 5.3, 4.8, 4.8, 4.9, 4.1, 4.3 mm, Sacomar, Angola, 4-11 m (CER); 53: 4.6 mm, Baia das Pipas, Angola; 54: protoconch, Sacomar.
Figuras 46-54. Mitrella psilla. *46-52: conchas, 4,7, 5,3, 4,8, 4,8, 4,9, 4,1, 4,3 mm, Sacomar, Angola, 4-11 m (CER); 53: 4.6 mm, Baia das Pipas, Angola; 54: protococha, Sacomar.*

up to north Spain, Archipelagos of Azores and Canaries, and Angola. Curiously there are no records for the west African coast of the Gulf of Guinea.

Remarks: In the present work we include photographs of specimens from Galicia, north Spain, Camariñas, (Figs. 28, 29) and A Guarda, (Fig. 33), Oran, Algeria (Fig. 30), Canary Islands (Figs. 31), Angola (Fig. 32), and the protoconch of another shell from the Sahara (Fig. 34), some of these previously figured in ROLÁN AND TRIGO (2000). All of them show a similar form and even colour pattern within some population variability. The wide distribution of *M. pallaryi* is explained if we consider the multispiral protoconch. The species is variable in colour and pattern, but the main characters are similar in shells from distant localities.

The lack of collecting records in some areas may be due to its peculiar habitat, in deep and rocky bottoms, and probably this species will be collected in other localities from West Africa which are still scarcely sampled. Anyway, up to now it was not collected between Senegal and Angola and may have a bipolar distribution.

Mitrella psilla (Duclos, 1846) (Figs. 35-54, 132-135, 143, 156, 165, 169)

Colombella psilla Duclos, 1846. Hist. natur...Genre *Colombelle*, pl. 15, fig. 5-6. [no type locality].
Colombella japix Duclos, 1850. Hist. natur...Genre *Colombelle*, pl. 22, fig. 13-14. [no type locality].

Type material: Syntypes of *C. psilla* and *C. japix* in MNHN.
Other material examined: Mauritania: 30 s, 50 j, Baie de L'Etoile, intertidal (MNHN); 217 sp, 14 s, 38 j, Baie de l'Etoile, intertidal, in algae (CER); 16 s, Banc d' Arguin, in beach sediment (CER). Senegal: 200 sp, 8 c, Region de Dakar (MNHN). Congo: 1 s, Pointe Indienne, 1 m (CPH). Angola: 3 sp, Lobito, 4 m (CER); 63 sp, 4 s, 8 j, Sacomar, 4-11 m (CER); 4 sp, Limagens, 5 m (CER); 1 s, Santiago, 5 m (CER); 53 sp, 10 s, 10 j, Praia Amelia, 5-11 m (CER); 1 sp, 15 c, 6 j, Praia Amelia, Namibe (MNHN); 3 j, Ponta de Noronha (MNHN); 5 j, Baia de Lucira (Bissonga), Namibe (MNHN); 2 sp, 1 c, 3 j, Baia do Cesar, intertidal (CER); 8 s, 2 j, Chapeu Armado, 5 m (CER); 10 s, 4 j, Baia das Pipas, 2-10 m (CER); 5 j, São Nicolau, Namibe (MNHN); 1 s, Bentiava [formerly São Nicolau], Namibe (CER);3 sp, 2 c, Praia das Conchas, Namibe (MNHN).

Description: As there are different populations, this description is general for all of them. The differences are pointed out below.

Shell (Figs. 35-44, 46-53) ovoid elongate, solid, with a last whorl larger than half the height.

Protoconch (Figs. 45, 54, 132, 133) apparently smooth, with 1 $^{1}/_{4}$ spiral whorls, clearly demarcated from the beginning of the teleoconch, diameter about 600 µm with nucleus 260 µm. Colour light with a dark brown spiral band, except in the Mauritanian population which is totally dark brown. Microsculpture of protoconch (Figs. 134, 135) only visible with high magnification and forming a rough surface.

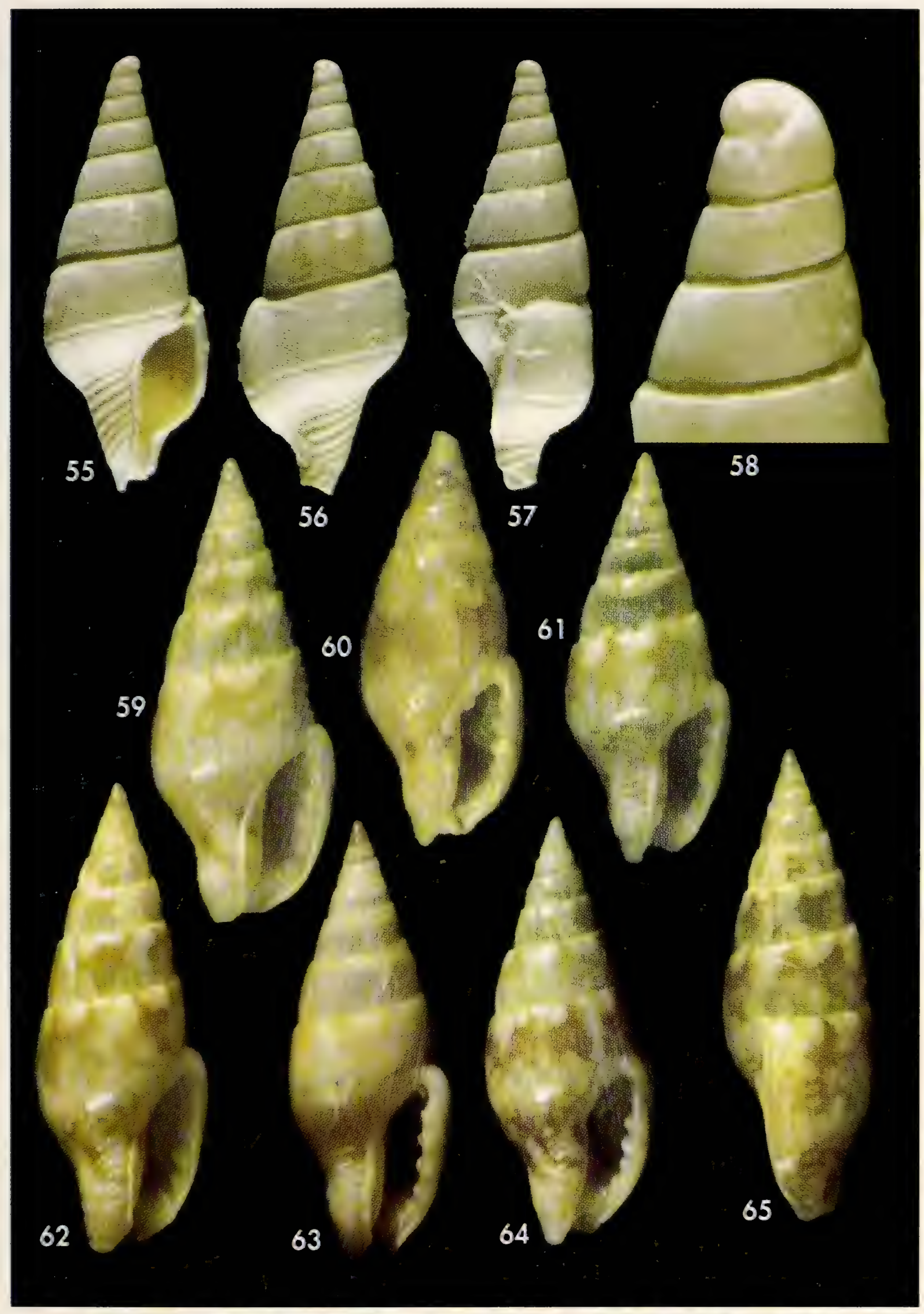
Teleoconch with 4 whorls, shiny, suture not impressed, with whorl profile scarcely convex, without any sculpture. Aperture relatively elongate with small teeth on the columella and about 4-5 denticles on the inner part of the outer lip.

Colour light brown to yellowish on background, lighter near the suture and with a band in the middle of the last whorl; numerous, whitish or cream ocellate patterns superimposed on this background all over the surface. Aperture elongate and narrow. External lip wide, thicker externally.

Dimensions: Usually between 4.5 and 5.3 mm.

Soft parts in Mauritanian population (Fig. 169) creamy-white, with numerous circular grey ocelli and dark rings in the middle of the tentacles and the extremity of the siphon.

Radula (Fig. 156) studied in specimens from l'Etoile, Mauritania and Sacomar, Angola, with central tooth



Figures 55-58. *Mitrella dartevellei*. 55-57: holotype, 8.9 mm, Gabon, (ZMC) ; 58: protoconch. Figures 59-65. *Mitrella melvilli*. 59-61: shells, 8.5, 7.2, 7.4 mm, Palmeirinhas (CER); 62-65: shells, 10.7, 10.3, 9.8, 10.7 mm, off Luanda, 40-60 m (CER).

Figuras 55-58. Mitrella dartevellei. *55-57: Holotipo, 8,9 mm, Gabón, (ZMC) ; 58: Protoconcha. Figuras 59-65.* Mitrella melvilli. *59-61: conchas, 8,5, 7,2, 7,4 mm, Palmeirinhas (CER); 62-65: conchas, 10,7, 10,3, 9,8, 10,7 mm, Luanda, 40-60 m (CER).*

three times as wide as long with hardly acute posterior corners. Lateral teeth about three times as long as wide, with strongly twisted base; cutting edge of laterals with basal cusp relatively wide at the base and blunt distally, central cusp narrow and sharpened, apical cusp longer and acute.

Operculum (Figs. 143, 165) corneous, ovoid, light brown, with the insertion partially divided by a prominence.

Distribution: *M. psilla* is known from Mauritania, Senegal and Angola.

It is curious that we have not found shells of the present species in the area located between Senegal and Angola, mainly in Ghana, well sampled by Peter Ryall (pers. comm.) and by the author, neither is it referred to by BERNARD (1984) in his book on Shells of Gabon. The presence of this species in some parts of this poorly known area is very probable, but also possibly the species has a bipolar distribution.

Remarks: The shells from Mauritania (Figs. 35-44) are frequently darker in colour, more translucent, and with an evanescent colour pattern, in which the circles are not well delimited; sometimes these shells are almost without any pattern. The colour of the protoconch and the first whorls is dark brown.

The shells from Dakar are similar but the colour pattern of circles is usually well marked and evident.

The shells from Angola (Sacomar and Praia Amelia) (Figs. 46-52) are more defined in colour and in ocellate pattern; the colour of the protoconch is light yellow with a darker sutural band; the shells from Baia das Pipas are similar but more translucent (Figs. 53).

In spite of the differences found between populations from Mauritania, Senegal and Angola, the comparison of the characters of the shell, size, protoconch, microsculpture of the protoconch and radula did not show differences. We therefore consider all these populations conspecific.

This species has been synonymized with doubts by WAGNER AND ABBOTT (1978) with *Mitrella baccata* (Gaskoin, 1852), from the Caribbean, but this species is different, with only some similarities in the shell.

Mitrella broderipi (G.B. Sowerby, 1844), described from Alborán Sea but present in north Africa, is larger and wider, more solid, has a wider protoconch (see Figs. 131 and 132), and different radula (Figs. 155 and 156) and operculum (Figs. 142 and 143).

M. alvarezi Rolán and Luque, 2001, from the Cape Verde Islands, is another small species and sometimes has ocelli, but is smaller and the radulae (Figs. 151 and 156) and operculum (Figs. 162 and 165) are also different.

Mitrella denticulata (Duclos in Chenu, 1840), living in Senegal, is similar but larger, darker, with ocelli only in few bands, larger light blotches below the suture and a light apex.

Mitrella dartevellei (Knudsen, 1956) (Figs. 55-58)

Pyrene dartevelli Knudsen, 1956. *Atlantide Report*, 4: 31, plate 2, figs. 8, 9. [Type locality: Stn. 123, 2° 03'S, 9° 05'E, 50 m off Gabon].

Type material: Holotype in ZMUC (Figs. 55-58).
Other material examined: Gabon: 2 s, "N' kondo" oilfield, 2° 34.1' S, 9° 00' E, 120 m (MNHN).

Description: See KNUDSEN (1956). Shells have been illustrated in KNUDSEN (1956) and in BERNARD (1984). The protoconch is paucispiral (Fig. 58).

Dimensions: Type material 8.9 to 9.3 mm in length.

Distribution: Only known from Gabon, where it is probably endemic.

Remarks: The narrow base, the deep suture and the peripheral groove, always very evident, are diagnostic characters that clearly differentiate it from other species of the area of study.



Figures 66-77. *Mitrella melvilli*. 66: holotype, 8.9 mm (ZMUC); 67-75: shells, 9.5, 11.0, 11.0, 8.6, 9.4, 9.5, 10.0, 9.6, 8.9 mm, Corimba, Luanda, 20 m (CER); 76: detail of the aperture; 77: protoconch.

Figuras 66-77. Mitrella melvilli. 66: holotipo, 8,9 mm (ZMUC); 67-75: conchas, 9,5, 11,0, 11,0, 8,6, 9,4, 9,5, 10,0, 9,6, 8,9 mm, Corimba, Luanda, 20 m (CER); 76: detalle de la abertura; 77: protoconcha.

Mitrella melvilli Knudsen, 1956 (Figs. 59-77, 140, 158, 167)

Pyrene melvilli Knudsen, 1956. *Atlantide Report*, 4: 33, pl. 2, fig. 11. [Type locality: Stn. 145, 9° 20'N, 14° 15'W, 32 m, Guinea Conakry].

Type material: Holotype (Fig. 66) of *Mitrella melvilli* in ZMUC.

Other material examined: Senegal: 1 s, Dakar, 14° 23.5' N, 17° 24.5' W, 65-70 m (MNHN). Ivory coast: 7 s, Abidjan region (MNHN). Nigeria: 2 s, 04° 03' N, 06° 12' E (MNHN). Congo: 1 s, Pointe Noire, Plage Mardamie (CPH). Angola: 56 sp, 10 s, Corimba, Luanda, 10-20 m (MNHN); 106 sp, 12 s, 23 j, Corimba, Luanda, 20 m (CER); 12 s, 26 j, Mussulo (MNHN); 24 sp, 4 s, 2 j, Ilha de Luanda, 40-60 m (MNHN); 10 sp, 5 s, 6j, off Mussulo, Luanda, 90-100 m (MNHN); 2 s, Palmeirinhas, Luanda (MNHN); 20 sp, 19 s, 10 j, Palmeirinhas, Luanda, 4-8 m (CER); 4 s, 6 j, Piambo, 3 m (CER); 1 s, Punta das Lagostas, 5-20 m (MNHN); 10 sp, 3 s, Luanda, 10 m (CER); 3 sp, 10 s, 5 j, off Luanda, 40-60 m (CER); 8 sp, 6 s, 8 s, Praia Amelia, 5 m (CER).

Description: See also KNUDSEN (1956). Shell (Figs. 59-75) rather solid, elongate and sharply pointed.

Protoconch (Figs. 77, 140) with 3 1/4 smooth spiral whorls, scarcely convex with a nucleus of about 130 µm and a diameter of about 650 µm, difficult to measure because the protoconch and the beginning of the teleoconch are not clearly demarcated. Colour of protoconch light brown, sometimes with a more evident spiral band.

Teleoconch with about 6-7 spiral whorls which are smooth, shiny, almost flat in profile, with a superficial suture, and a narrow shelf.

Aperture (Fig. 76) narrow, columella curved with very small tubercles, about 6 in number. External lip with about 6 teeth, the second and the third from the upper part larger than the rest.

Colour pattern consisting of a cream background and yellowish or light brown irregular ovoid figures, forming a net, larger below the suture. In some parts this pattern changes to one of brown blotches.

Dimensions: holotype 8.9 mm; largest shells studied 11.5 mm.

Soft parts unknown.

Radula (Fig. 158), studied in Angolan specimens, with a central tooth two and a half times as wide as long and almost rectangular with hardly acute posterior corners. Lateral teeth about three times as long as wide, with strongly twisted base; cutting edge of laterals with basal cusp wide in the base and rounded distally, central cusp short and sharpened, and apical cusp much longer and acute.

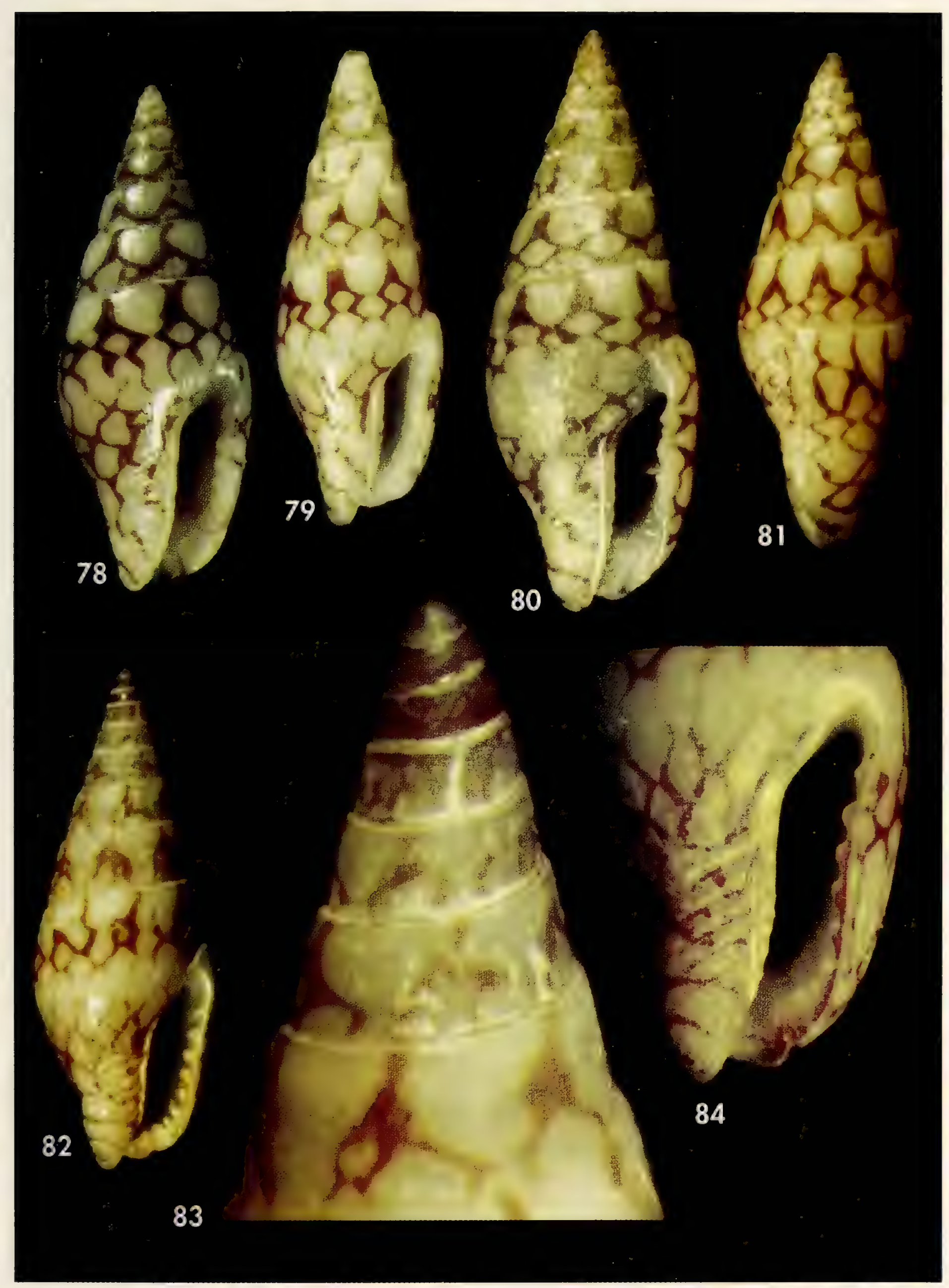
Operculum (Fig. 167) ovoid and somewhat elongate, light brown, almost transparent, with an ovoid mark of insertion which has an angular prominence in the middle.

Distribution: Described from Guinea Conakry, this species is also known from Senegal, Ivory Coast, Nigeria and Angola. Probably not present in islands of the Gulf of Guinea (São Tomé, Principe, Annobon) never found in spite of many samplings.

Remarks: The holotype of *M. melvilli* is a slightly faded shell but it still retains the typical pattern of the species in the first whorls.

HEDLEY (1899) described a *Columbella melvilli* from Micronesia (Funafuti). Hedley's species is not a true *Columbella* and if it is indeed a *Mitrella* this could mean that the name for the African species is pre-occupied. The characters of the Hedley species probably fit better within *Pyrenola* Iredale, 1918, which was considered a subgenus of *Mitrella*, but may be a true valid genus. For this reason, and pending of further study, we keep the name *M. melvilli* for the African species.

The closest species are *M. africana* spec. nov. (see below) and *M. aemulata* spec. nov. (see below for differences). *M. africana* has a multispiral protoconch, but is different in colouration, and lives sympatrically in some areas; *M. aemulata* has a paucispiral protoconch.



Figures 78-84. *Mitrella africana* spec. nov. 78: holotype, 8.8 mm, Palmeirinhas, Luanda, Angola (MNCN); 79: shell, 7.5 mm, Miamia, Ghana (CER); 80, 81: shells 9.1, 7.9 mm, Mbini, Equatorial Guinea (CER); 82: shell, 7.9 mm, Palmeirinhas, Angola (CER); 83: protoconch of the shell of the Figure 82; 84: detail of the aperture, shell of the Figure 82.

Figuras 78-84. Mitrella africana *spec. nov. 78: holotipo, 8,8 mm, Palmeirinhas, Luanda, Angola (MNCN); 79: concha, 7,5 mm, Miamia, Ghana (CER); 80, 81: conchas 9,1, 7,9 mm, Mbini, Equatorial Guinea (CER); 82: concha, 7,9 mm, Palmeirinhas, Angola (CER); 83: protoconcha de la concha de la Figura 82; 84: detalle de la abertura, concha de la Figura 82.*

Mitrella africana spec. nov. (Figs. 78-84, 141, 157, 164, 168)

Type material: Holotype (Fig. 78) in MNCN (15.05/46629). Paratypes in the following: AMNH (1), BMNH (1), MNHN (1), ZSM (1), CJH (1), CFB (1), CER (8), CPR (1), all from the type locality.
Other material examined: Senegal: 5 s, Region de Dakar (MNHN); 1 s, Fleuve Casamance, Zinguinchor, 3-4 m (MNHN). Guinea Conakry: 3 s, Mission Gruvel (MNHN); 3 s, Iles Bissagos, Mission Gain (MNHN); 15 sp, 47 s, 10 j, Ile de Los, 8-18 m (MNHN). Ivory Coast: 3 s, drag. continental shelf (MNHN). Ghana: 8 s, Miamia, 8-12 m (CER); 5 sp, 3 s, Takoradi, 4-8 m (CER); 1 sp, Busua, between the beach and Abokwa Islet, 5 m (CER). Equatorial Guinea: 3 s, Mbini, intertidal (CER). Gabon: 4 sp, Cap Esterias, 0-3 m (MNHN). São Tomé e Principe: 4 s, Baia de Santo Antonio, Principe, 8 m (CER). Congo: 1 sp, 12 s, ORSTOM beach, Pointe Noire, 5-7 m (MNHN). Angola: 3 s, region Ambrizete 07° 17.49′ N, 12° 53.05′ E (MNHN); 40 sp, 68 s, 27 j, Barra do Dande, Bengo, infralitoral rocks (MNHN); + 300 sp, + 100 s, Cacuaco, Bengo, infralittoral rocks (MNHN); 1 s, off Luanda, 40-60 m (CER); 1 sp, Cacuaco, Luanda, 2-6 m (CER); 2 s, Cabo Ledo, Luanda, 40 m (MNHN); 1 sp, Morro dos Veados, intertidal (CER); 1 s, 1 j, Palmeirinhas, 3-6 m (CER).
Type locality: Luanda, Angola.
Etymology: The name reflects the widespread distribution of this species along the West African coast.

Description: Shell (Figs. 78-82) solid, lanceolate, with a pointed spire.

Protoconch (Figs. 83, 141) smooth, of about 2 1/2 slightly convex spiral whorls, with a diameter of about 520 µm and a nucleus of 120 µm, difficult to measure because the protoconch and the beginning of the teleoconch are not clearly demarcated. Colour of protoconch light brown or cream, sometimes with a more evident dark, spiral band.

Teleoconch with about 6 spiral whorls which are smooth, shiny, almost flat in profile, with a superficial suture, almost smooth.

Aperture (Fig. 84) narrow, columella curved with very small, inconspicuous tubercles. External lip with about 6 teeth of similar size in the upper part, and smaller ones in the lower part.

Colour pattern formed by a whitish-cream background and a reddish reticulation forming ovoid figures from which the subsutural are larger.

Dimensions: Holotype 8.8 mm, largest shell studied 10 mm.

Animal (Fig. 168) drawn from material collected in Ghana: background colour cream with small yellowish spots; irregular blotches of violet-reddish (similar to that of the shell) along the lateral sides of the foot, on the tentacles, behind the eyes and on the siphon, with a ring of this colour near the tip.

Radula (Fig. 157) with a central tooth three times as wide as long and with hardly acute posterior corners. Lateral teeth about three times as long as wide, with strongly twisted base; cutting edge of laterals with basal cusp relatively wide basally and blunt distally, placed close to the central one, which is close to the apical, both being short and acute.

Operculum (Fig. 164) light brown, ovoid, rather transparent, with a mark of insertion of similar form, which is almost divided in two by an elongate prominence along the middle part of the longer axis.

Distribution: From Senegal to Angola, including the islands of the Guinean Gulf.

Remarks: This species has been illustrated from Gabon in KNUDSEN (1956) and BERNARD (1984) as *Pyrene parvula* (Dunker, 1847). The taxon *M. parvula* Dunker, 1847 is (after RIOS, 1985) a synonym of *M. argus* (Orbigny, 1842) and this species is considered by DE JONG AND COOMANS (1977) synonym of *M. dichroa* Sowerby, 1844. The type locality mentioned in the original description is "Ind. occid.?" and this is commented in PACE (1902) and in VAN AARTSEN *ET AL.* (1984). The type material is not known. The description of this taxon is not corresponding clearly with any West African species and so we agree with van AARTSEN *ET AL.* (1984) considering it *nomen dubium*. Furthermore, this name probably is pre-occuped by *Fusus bucci-*



Figures 85-88. *Mitrella aemulata* spec. nov. 85-87: holotype, 7.7 mm, Annobon (MNHN); 88: protoconch.
Figuras 85-88. Mitrella aemulata *spec. nov. 85-87: holotipo, 7,7 mm, Annobón (MNHN); 88: protoconcha.*

noides var. *parvula* Grateloup, 1833 and by *Buccinum columbelloides* var. *parvula*, Grateloup, 1847. The American shell of *M. dichroa* is similar but a little smaller and the brownish spiral part among the ocelli is on the lower part of the whorls instead to be subsutural.

The West African closest species to *M. africana* is the sympatric *M. melvilli* Knudsen, 1956 which is similar in size and pattern, both having a multispiral protoconch. *M. africana* has only about 2 1/2 whorls of protoconch, while *M. melvilli* has 3 1/4 (see Figs. 140, 141). The colour is yellowish in *M. melvilli* but reddish in *M. africana*. Finally, the colour pattern is similar, but better differentiated in *M. africana* where the subsutural oval figures are always very well marked, and more constant, while in *M. melvilli* it may even disappear, being more variable, with parts bearing only light brown blotches. The apertural tubercles on the external lip are different, the second-third are larger in *M. africana*. In Angola, both species live sympatrically in several places.

M. ocellata Gmelin, 1791, from the north of the West African coast, has a pattern with ocelli but its size is larger, the ocelli more uniform, and the operculum (see Figs. 144 and 164) and radulae are different (see Figs. 153, 154 and 157).

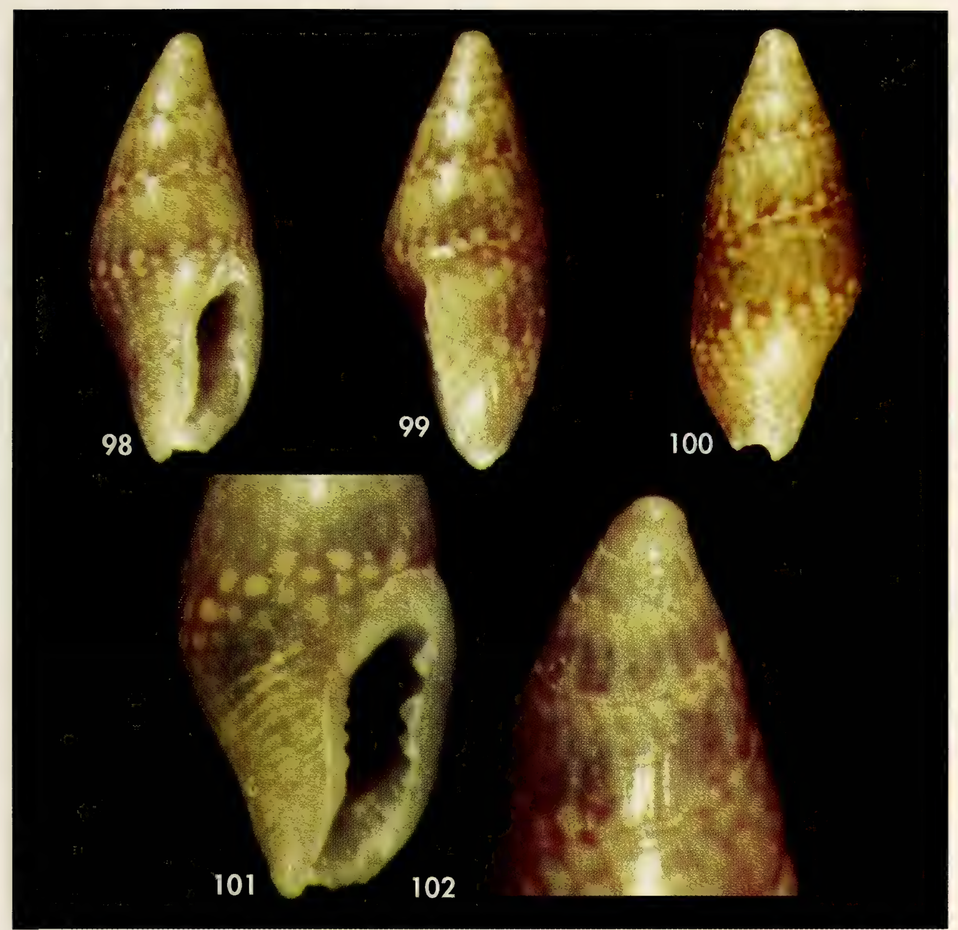
Some colour forms of *Anachis valledori* Rolán and Luque, from the Cape Verde Islands, may be confused with *M. africana*, but that species always has axial ribs, a paucispiral protoconch and differences in radula (see Figs. 150 and 157) and operculum (Figs. 161 and 164).

Mitrella aemulata spec. nov. (Figs. 85-88)

Type material: Holotype (Figs. 85-87) in MNHN (from A. Crosnier coll.).
Other material examined: Equatorial Guinea: 3 f, 1 j, San Antonio de Palé, Annobon (CER), 2-3 m.
Type locality: Equatorial Guinea, Annobon, 1° 26′ S, 5° 37′ 30″E, 20-40 m.
Etymology: The specific name is derived from the latin word "aemulatus" which means "imitate", and makes allusion to the similarity of this species with *M. melvilli*.



Figures 89-97. *Mitrella inesitae* spec. nov., Esprahinha, São Tomé. 89: holotype, 10.0 mm (MNCN); 90-95: paratypes: 10.8 (MNHN), 9.6 (BMNH), 10.5 (AMNH), 10.1 (ZSM), 10.5 (CER) and 9.4 mm (CER); 96: detail of the aperture of the holotype; 97: protoconch of the holotype.
Figuras 89-97. Mitrella inesitae *spec. nov., Esprahinha, Santo Tomé. 89: holotipo, 10,0 mm (MNCN); 90-95: paratipos: 10,8 (MNHN), 9,6 (BMNH), 10,5 (AMNH), 10,1 (ZSM), 10,5 (CER) y 9,4 mm (CER); 96: detalle de la abertura del holotipo; 97: protoconcha del holotipo.*



Figures 98-102. *Mitrella saotomensis* spec. nov. 98-100: holotype, 4.4 mm, Praia Mutamba, São Tomé (MNCN); 101: detail of the aperture of a paratype (CER); 102: protoconch of the holotype.
Figuras 98-102. Mitrella saotomensis *spec. nov. 98-100: holotipo, 4,4 mm, Praia Mutamba, Santo Tomé (MNCN); 101: detalle de la abertura de un paratipo (CER); 102: protoconcha del holotipo.*

Description: Shell (Figs. 85-87) ovoid elongate, solid, with a last whorl more than half the height.

Protoconch (Fig. 88)) with only one smooth spiral whorl, with a diameter of about 750 µm. Colour of protoconch light brown with two dark bands above and below the suture.

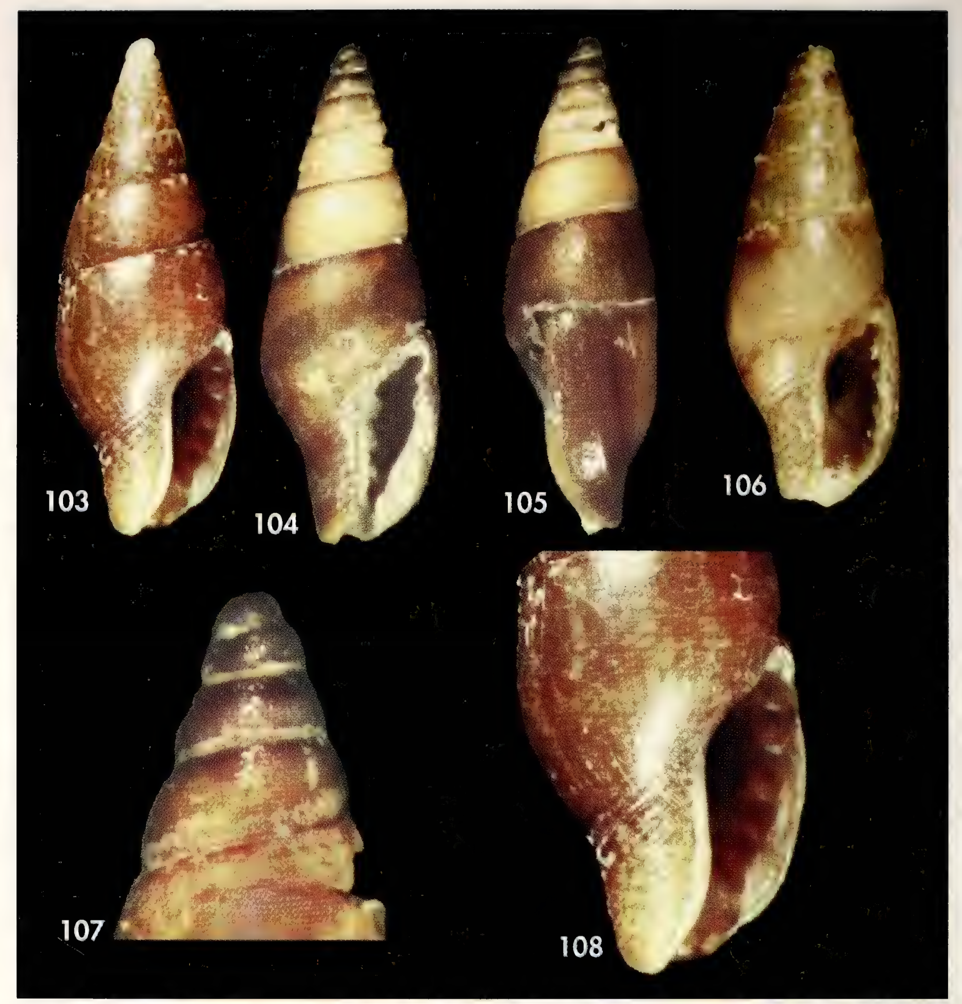
Teleoconch with about 5 spiral whorls which are smooth, shiny, almost flat in profile, with a superficial suture.

Aperture narrow, columella S-shaped with very small tubercles, about 5 in number. External lip, with about 6 teeth, the second and third from the top being a little larger than the rest.

Colour pattern formed by a cream background and a yellowish or light brown irregular reticulation forming ovoid figures, which are larger below the suture, with a suprasutural spire band formed by small, white, axial blotches.

Dimensions: Holotype 7.7 mm in length.

Distribution: Only known from the holotype and some fragments from



Figures 103-108. *Mitrella tenebrosa*. 103: holotype, 8.4 mm, Esprainha, São Tomé (MNCN); 104, 105: paratype, 8.0 mm, (CPR); 106: paratype, 7.6 mm, (MNHN); 107: protoconch; 108: detail of the aperture.

Figuras 103-108. Mitrella tenebrosa. *103: holotipo, 8,4 mm, Esprainha, Santo Tomé (MNCN); 104, 105: paratipo, 8,0 mm, (CPR); 106: paratipo, 7,6 mm, (MNHN); 107: protoconcha; 108: detalle de la abertura.*

Annobon island, from where it is probably endemic.

Remarks: The most similar species to *M. aemulata* is *M. melvilli*, from continental Gulf of Guinea, but the protoconch of this latter species is multispiral, while that of *M. aemulata* is paucispiral with only one spiral whorl. It is probable that this species originated from a common ancestor with *M. melvilli* and, living in isolated conditions in an insular area, evolved from a planktotrophic to a lecitotrophic larval development.

Mitrella bruggeni van Aartsen, Menkhorst and Gittenberger, 1984, from the Mediterranean and Canary Islands, has a similar aspect but is larger and wider, with a more ovoid aperture and more denticles on the outer lip.



Figures 109-117. *Mitrella annobonensis*. 109-111: holotype, 4.8 mm, San Antonio de Palé, Annobon, Guinea Equatorial (MNCN); 112-114: paratypes: 4.7 mm (MNHN), 4.5 mm (AMNH), 4.0 mm (CER), all from type locality; 115, 116: protoconch; 117: detail of the aperture.
Figuras 109-117. Mitrella annobonensis. *109-111: holotipo, 4,8 mm, San Antonio de Palé, Annobón, Guinea Equatorial (MNCN); 112-114: paratipos: 4,7 mm (MNHN), 4,5 mm (AMNH), 4,0 mm (CER), todas de la localidad tipo; 115, 116: protoconcha; 117: detalle de la abertura.*

Mitrella inesitae spec. nov. (Figs. 89-97, 136, 145-147, 166)

Type material: Holotype (Fig. 89) deposited in the MNCN (15.05/46630). Paratypes in the following: AMNH (1, Fig. 92), BMNH (1, Fig. 91), MNHN (1, Fig. 90), ZSM (1, Fig. 93), CJH (4), CFB (10), CER (75, Figs. 94, 95), CPR (1), all from the type locality.
Other material examined: Equatorial Guinea: 12 f, 7 j, San Antonio de Palé, Annobon, 10-15 m (CER). São Tomé: 1 s, Morro Peixe (MNHN); 8 j, Praia Mutamba, infralittoral rocks (MNHN); 3 s, Calypso, st. 14 40° 34′ N, 08° 32′ W (MNHN); 20 sp, 21 s, 19 j, Esprainha (Neves), infralitoral (MNHN); 136 sp, 14 s, 41 j, Lagoa Azul, 4-8 m (CER); 37 sp, 6 s, 37 j, Esprainha, 6-10 m (CER); 8 s, Praia Mutamba, 4-8 m (CER).
Type locality: Esprainha, east coast of São Tomé, Republic of São Tomé and Principe.
Etymology: The specific name is after the author' s niece Inés Álvarez Torres, of Trubia, Oviedo, Spain, companion on many collecting trips.

Description: Shell (Figs. 89-95) fusiform, solid, with a last whorl larger than half the height.

Protoconch (Figs. 97, 136) short, smooth, difficult to distinguish from the beginning of the teleoconch, with about one and a half whorls, yellowish in colour, sometimes darker, scarcely lighter in the suture, about 620 µm in diameter with nucleus about 230 µm.

Teleoconch with 6-7 whorls, smooth, shiny, suture not impressed, profile almost flat.

Aperture (Fig. 96) elongate and narrow. External lip thickened externally, internally with some teeth present, the first one standing out alone and separated from the second. Second tooth largest, sometimes seeming to be formed by the fusion of two, third tooth a little smaller and the remaining three or four down to the base, very small. Inner lip with small tubercles on its lower part. Siphonal canal short and wide.

Background colour brown, with numerous yellowish or cream ocellate patterns overall, which are small and a little elongated spirally. Subsutural area frequently with larger brown blotches and between them areas with white or cream colour. In some shells, another similar band in the middle of the last whorl, partially visible above the suture of spire whorls. Basal area with 12-16 spiral cords.

Dimensions: Most shells between 9.00 and 11.0 mm, holotype 10.0 mm in height.

Soft parts unknown.

Radula (Fig. 147) with a central tooth two times as wide as long and with rounded corners. Lateral teeth about three times as long as wide with strongly twisted base; cutting edge of laterals with basal cusp wide basally and blunt distally, central and apical cusps narrow and acute.

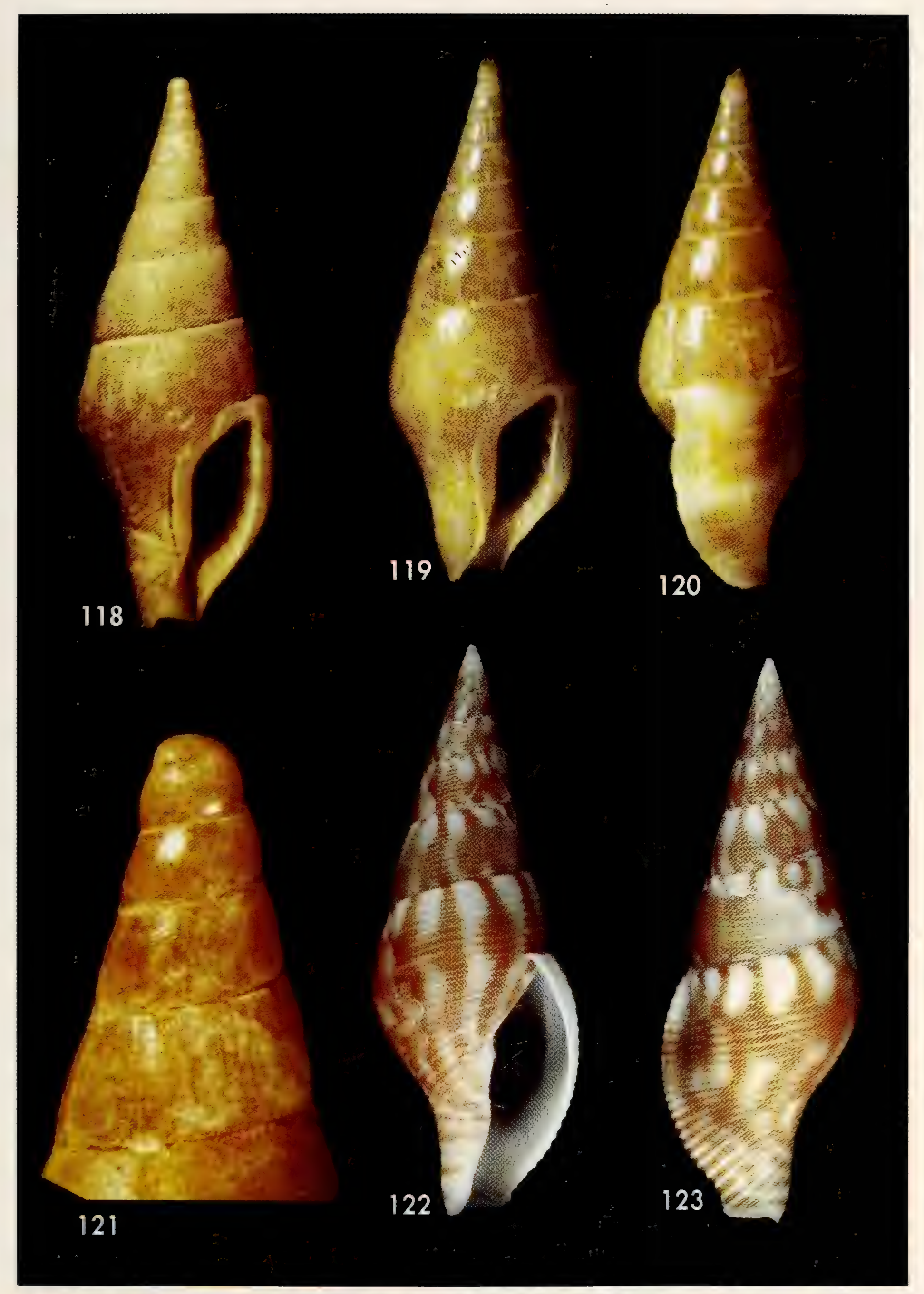
Operculum (Fig. 145, 146, 166) corneous, ovoid, light brownish, with the insertion mark also ovoid elongate and with a very small prominence at the middle.

Distribution: Only known from São Tomé from where it is probably endemic.

Remarks: *Mitrella inesitae* spec. nov. is different from most of the west African species which are smaller, except *M. pallaryi* which is wider, has a multispiral protoconch and a different pattern. The most similar Mediterranean species is *M. scripta* (Linné, 1758) which is larger and with a more variable colour pattern. They can be differentiated because the aperture of *M. inesitae* is relatively more elongate, and the tubercles on the columella are smaller, while those on the external lip are larger, the upper one being more separated from the second.

Mitrella lanceolata (Locard, 1886), from the Mediterranean, is more elongate, with a wider and relatively shorter aperture and a simpler colour pattern.

Some elongate specimens of the Mediterranean *M. gervillii* (Payraudeau, 1826) may have a similar aspect, but they are very large, with a wider aperture and smaller denticulation in it.



Figures 118-121. *Mitrella condei* spec. nov. 118: holotype, 16.5 mm, Santa María, Angola (MNHN); 119-120: paratype, 16.2 mm, Santa Maria, Angola (MNCN); 121: protoconch of the holotype. Figures 122, 123. *Cotonopsis molfinsi*, 40 mm, (CJH).

Figuras 118-121. Mitrella condei *spec. nov. 118: holotipo, 16,5 mm, Santa María, Angola (MNHN); 119-120: paratipo, 16,2 mm, Santa Maria, Angola (MNCN); 121: protoconcha del holotipo. Figuras 122, 123.* Cotonopsis molfinsi, *40 mm, (CJH).*

Mitrella saotomensis spec. nov. (Figs. 98-102, 137)

Type material: Holotype (Figs. 98-100) in MNCN (15.05/46631); paratypes: CER (1 s, without apex, Fig. 101), CJH (2 s).
Other material examined: São Tomé: 14 f, Praia Mutamba, 3-8 m (CJH); 1 f, Praia Mutamba, 2-8 m (CER); 15 f, Lagoa Azul (CHD).
Type locality: Praia Mutamba, São Tomé, 5 m, Republic of São Tome and Principe.
Etymology: The specific name is after the island where the species was collected.

Description: Shell (Figs. 98-100) fusiform, solid, with a last whorl larger than half the height.

Protoconch (Figs. 102, 137) short, smooth, with 1 $^1/_4$ spiral whorls, clearly differentiated from the beginning of the teleoconch, because the spiral striation appears, diameter about 500 µm with nucleus 250 µm. Colour of protoconch yellowish with a darker sutural band, and a dark point in the apex.

Teleoconch with 4 whorls, shiny, suture not impressed, whorl profile almost flat. Spiral striae appearing at the beginning of the teleoconch, respectively, 6 in the first whorl, 10 in the second, 16 in the following and more that 60 on the last whorl; very small and closely spaced, except at the base of the shell, where the 17 lower ones are wider and define small spiral cords.

Aperture (Fig. 101) elongate and narrow. External lip widely thickened externally, internally with some teeth, the uppermost standing out alone separated from the upper extreme and from the second one. Second tooth largest, the following one a little smaller, the remaining four teeth, down to the base, very small. Inner lip with 5 small tubercles on its lower part. Siphonal canal short and wide.

Colour yellowish brown on background, darker near the suture with a band on the last whorl which continues the suture; this background covered by numerous yellowish or cream ocelli overall.

Dimensions: Holotype 4.5 mm in height.

Distribution: Only known from São Tomé Island, from where it is probably endemic.

Remarks: The main differences with the most similar species are the following:

Mitrella broderipi (Sowerby, 1844) and *M. bruggeni* van Aartsen, Menkhorst and Gittenberger, 1984, from the Alboran Sea, are larger, wider and with a wider aperture with smaller denticulation.

Mitrella alvarezi Rolán and Luque, 2001, from Cape Verde Islands, is larger, darker, with a more irregular pattern with parts without ocelli, and a totally smooth surface.

Mitrella psilla, from West Africa, is similar in size or slightly larger, but the shell is wider; its pattern is formed by larger ocelli, the aperture is wider, the teeth of the outer lip are regularly spaced, and it lacks the evident tubercles on the columella.

Mitrella tenebrosa spec. nov. (Figs. 103-108)

Type material: Holotype (Fig. 103) in MNCN (15.05/46632). Paratypes: CER (1), CPR (1, Fig. 104, 105), both from the type locality; MNHN (1, Fig. 106) from Neves, São Tomé.
Type locality: Esprainha, São Tomé, Republic of São Tome and Principe.
Etymology: The specific name alludes to its dark colour.

Description: Shell (Figs. 103-106) fusiform, solid, with a last whorl larger than half the height.

Protoconch (Fig. 107) studied in few shells and not in good condition; apparently short, smooth, perhaps with 1 $^1/_4$ to 1 $^1/_2$ spiral whorls, but difficult to distinguish from the beginning of teleoconch; diameter about 600 µm with nucleus about 250 µm. Colour of proto-



Figures 124-130. *Strombina descendens*, 124-127: shells of 20.2, 18.8, 20.2, 17.7 mm, Praia Amelia, Namibe, 40-60 m (MNHN); 128: Detail of the aperture; 129, 130: protoconch.
Figuras 124-130. Strombina descendens, *124-127: conchas de 20,2, 18,8, 20,2, 17,7 mm, Praia Amelia, Namibe, 40-60 m (MNHN); 128: detalle de la abertura; 129, 130: protoconcha.*

conch dark brown in the best preserved specimen.

Teleoconch with 4-6 smooth and hardly convex whorls, shiny, with suture impressed. Basal area with 8-10 spiral cords.

Aperture (Fig. 108) elongate and narrow. External lip slightly thickened externally. Internally, 6 strong teeth with a regular separation among them. Inner lip with 6 small tubercles on its lower part. Columella straight in the middle and curved at the extremes. Siphonal canal short and wide.

Background colour dark brown, darker near the suture and with very numerous small oval ocelli overall; in other shells this pattern is not seen because of erosion.

Dimensions: Holotype 8.4 mm in height, other shells slightly smaller.

Distribution: Only known from São Tomé, deeper than 15-20 m. As some crabbed material was collected in Esprainha, it is supposed that the species lives in deeper water.

Remarks: The closest species to *M. tenebrosa* and their main differences are the following:

Mitrella inesitae is sympatric, but its shell is larger, more elongate, wider, and with a more colourful pattern. The aperture is narrower and the upper teeth on the external lip are larger and more separated.

Mitrella pallaryi, from the European and West African coast, is a larger species with a multispiral protoconch.

Mitrella saotomensis is sympatric, and it has a smaller shell and its pattern is formed by circular ocelli. The teeth on the external lip are not regular.

Mitrella africana and *M. melvilli*, from the West African continental coast, have multispiral protoconch, are lighter in colour and the teeth on the external lip are different in size, the upper ones being larger.

Mitrella annobonensis spec. nov. (Figs. 109-117, 138, 139)

Type material: Holotype (Figs. 109-111) in MNCN (15.05/46633); paratypes in MNHN (1, Fig. 112), AMNH (1, Fig. 113) and CER (1, Fig. 114).
Type locality: San Antonio de Palé, Annobon, 10-15 m, Equatorial Guinea.
Etymology: The specific name is after the island where the species was found.

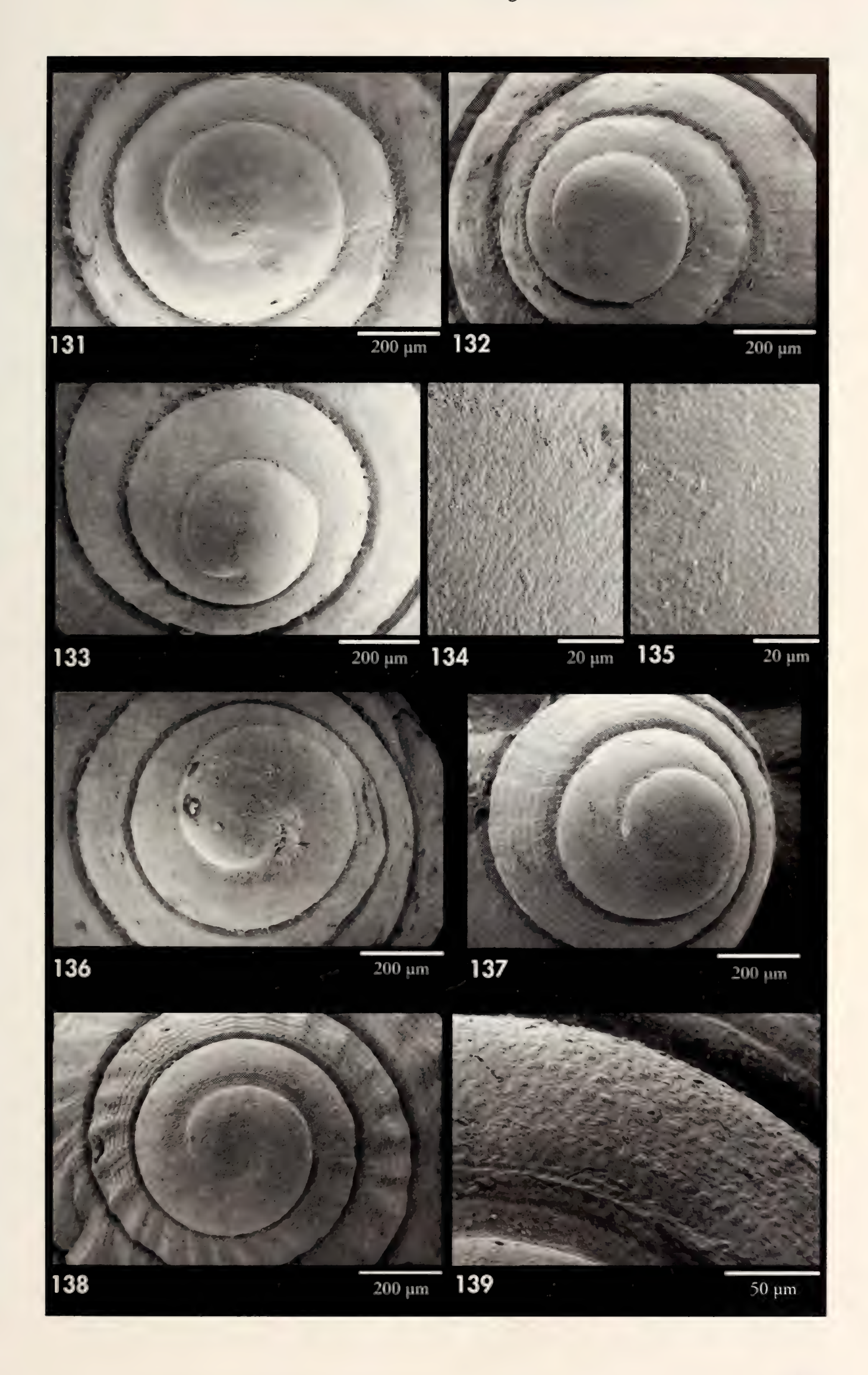
Description: Shell (Figs. 109-114) ovoid-conical, very solid, with a last whorl which represents $^{2}/_{3}$ of the height.

Protoconch (Figs. 116, 138), short, with 1 $^{1}/_{4}$ whorls, brown in colour, darker along the suture, diameter of about 520 µm with nucleus 230 µm, apparently smooth, but spiral lines with irregular nodules can be seen with high magnification (Fig. 139).

Teleoconch with about 4 whorls, shiny, suture not impressed, whorl profile almost flat. Termination of protoconch well defined because spiral striae appear at the

(Right page) Figures 131-139. Protoconchs and microsculpture. 131: *Mitrella broderipi*, l'Etoile, Nouadibou, Mauritania; 132: *Mitrella psilla*, l'Etoile, Nouadibou, Mauritania; 133: *Mitrella psilla*, Sacomar, Angola; 134: microsculpture of the protoconch of *M. psilla*, Sacomar; 135: microsculpture of the protoconch of *M. psilla*, L'Etoile; 136: *Mitrella inesitae* sp. nov., Lagoa Azul, São Tomé; 137: *Mitrella saotomensis* sp. nov., Praia Mutamba, São Tome; 138: *Mitrella annobonensis* sp. nov., San Antonio de Palé, Annobon; 139: microsculpture of the protoconch of *M. annobonensis* sp. nov.

(Página derecha) Figuras 131-139. Protoconchas y microsculpture. 131: Mitrella broderipi, *l'Etoile, Nouadibou, Mauritania; 132:* Mitrella psilla, *l'Etoile, Nouadibou, Mauritania; 133:* Mitrella psilla, *Sacomar, Angola; 134: microscultura de la protoconcha de* M. psilla, *Sacomar; 135: microscultura de la protoconcha de* M. psilla, *L'Etoile; 136:* Mitrella inesitae *sp. nov., Lagoa Azul, Santo Tomé; 137:* Mitrella saotomensis *sp. nov., Praia Mutamba, Santo Tome; 138:* Mitrella annobonensis *sp. nov., San Antonio de Palé, Annobón; 139: microscultura de la protoconcha de* M. annobonensis *sp. nov.*


131
200 µm
132
200 µm
133
200 µm
134
20 µm
135
20 µm
136
200 µm
137
200 µm
138
200 µm
139
50 µm

beginning of the teleoconch, 8 on the first whorl, 17 on the second, 27 on the following and very numerous and difficult to count on the last whorl. Spiral striae very small and very attenuated in some places. Basal area with about 15 well defined spiral cords. Irregular axial ribs present on all the whorls, about 15 on the first whorl and 25 on the following, less noticeable on the last whorl.

Aperture (Fig. 117) elongate and narrow. External lip widely thickened externally, internally with about 7 teeth, the uppermost being the largest, and the lower smaller. Inner lip with no tubercles. Siphonal canal short and wide.

Background colour reddish brown with numerous yellowish or cream ocelli overall, sometimes less marked on the convexity of the last whorl.

Dimensions: Holotype 4.8 mm in height.

Soft parts, operculum and radula unknown.

Distribution: Only known from Annobon, Equatorial Guinea, from where it is probably endemic.

Remarks: This species may be differentiated from any of the other known West African species of the genus because it is a very solid, short and relatively wider shell, with narrow aperture, and spiral striae:

Mitrella alvarezi Rolán and Luque, 2001 is larger, more fragile, darker, with a more variable pattern partially without ocelli, and a totally smooth surface.

Mitrella psilla is of similar size, but less solid and globose, the aperture is wider and the colour lighter, yellowish, with larger ocelli.

Mitrella broderipi (G. B. Sowerby, 1844) is larger, relatively wider, more fragile, the pattern is formed by larger ocelli, the aperture is wider, the teeth of the outer lip are regularly distant, and lacks tubercles on the columella.

Mitrella condei spec. nov. (Figs. 118-121)

Type material: Holotype (Fig. 118) in MNHN. Paratypes: 1 s, Baia de Lucira (Bissonga), Namibe, Angola (MNHN); 1 s, Santa Maria, Angola, (MNCN 15.05/46634).

Type locality: Praia Amelia, Namibe, Angola.

Etymology: The species is dedicated to the Spanish malacologist Javier Conde, Associate Editor of Iberus, for his continuous help in our work.

Description: Shell (Figs. 118-120) solid, conical elongate, smooth, with a large last whorl.

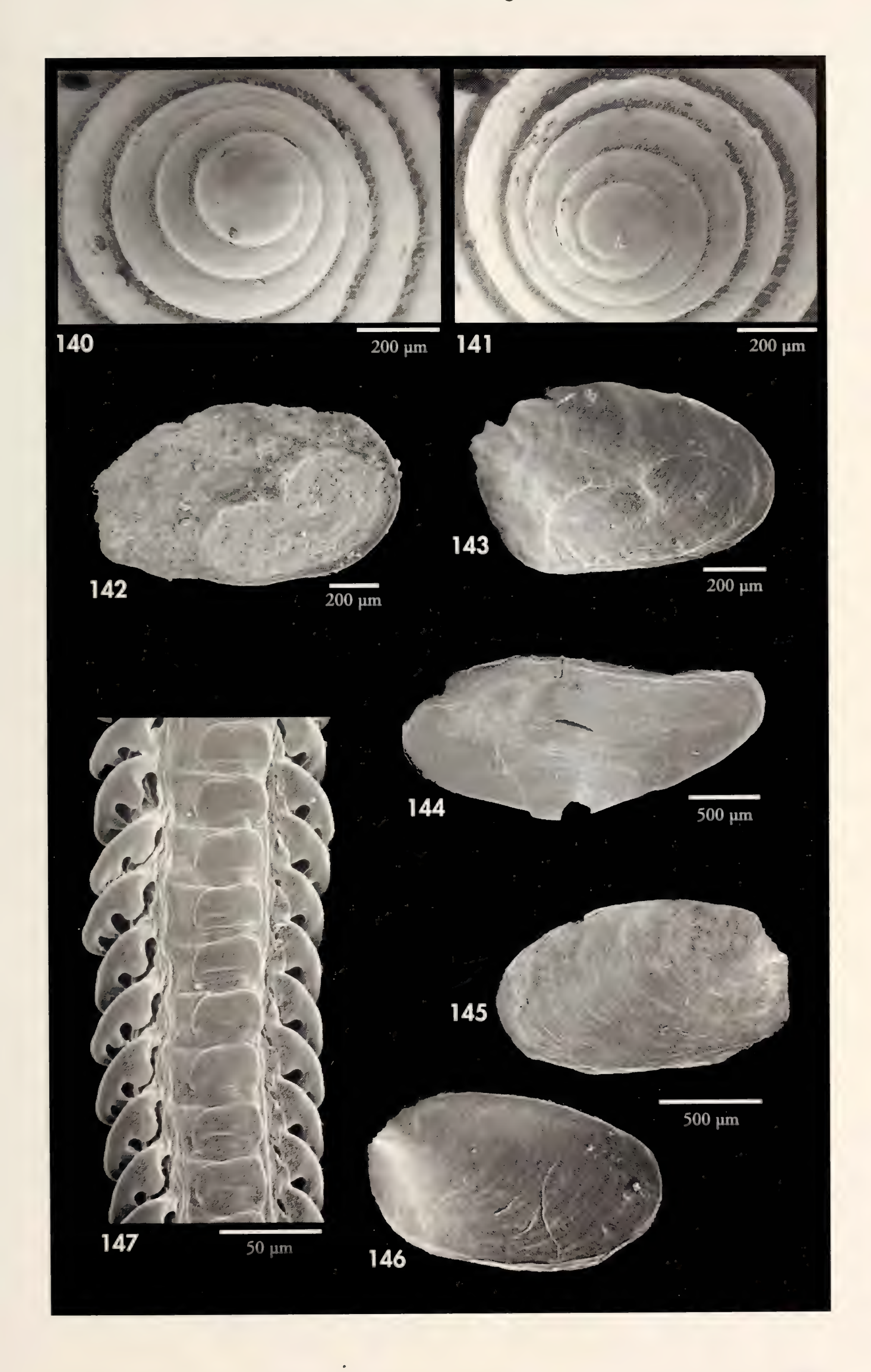
Protoconch (Fig. 121) difficult to see due to the lack of separation from teleoconch, probably of about 1 whorl, with diameter about 700 µm.

Teleoconch of about 7 whorls, totally flat, with suture incised but not deep. Last whorl large, with the same height as the spire, and with a peripheral angulation; from this angulation the profile of the shell is concave, the last whorl ending in a narrow base presenting 13 narrow spiral ribs.

Aperture rhomboidal, columella with its central part in the same direction as the axis of the shell, deviated above and below

(Right page) Figures 140, 141. Protoconchs. 140: *Mitrella melvilli*, Luanda, Angola; 141: *Mitrella africana*, Palmeirinhas, Angola. Figures 142-147. Opercula. 142: *Mitrella broderipi*, l'Etoile, Mauritania; 143: *Mitrella psilla*, Sacomar, Angola; 144: *Mitrella ocellata albine*. Dakar, Senegal; 145, 146: *Mitrella inesitae* sp., Lagoa Azul, São Tomé. Figure 147. Radula of *Mitrella inesitae* sp. nov. A. Lagoa Azul, São Tome.

(Página derecha) Figuras 140, 141. Protoconchas. 140: Mitrella melvilli, *Luanda, Angola; 141:* Mitrella africana, *Palmeirinhas, Angola. Figuras 142-147. Opercula. 142:* Mitrella broderipi, *l'Etoile, Mauritania; 143:* Mitrella psilla, *Sacomar, Angola; 144:* Mitrella ocellata albine. *Dakar, Senegal; 145, 146:* Mitrella inesitae *sp., Lagoa Azul, São Tomé. Figure 147. Rádula de* Mitrella inesitae *sp. nov. A. Lagoa Azul, São Tome.*


140
200 µm
141
200 µm
142
200 µm
143
200 µm
144
500 µm
145
500 µm
147
50 µm
146

forming an open S. On the external lip there are 8 teeth continued by lirae, number 2 and 3 being the largest.

Colour light brown formed by small oval ocelli oriented spirally.

Dimensions: Holotype 16.5 mm in height, other known specimens of similar size.

Soft parts, radula and operculum unknown.

Distribution: Only known from Angola.

Remarks: We consider that this species has similarity with *Mitrella minor* Scacchi, 1836, type species of the subgenus *Columbellopsis*, due the characteristic profile and the narrow base. At present, there is not complete agreement about the validity of the genus *Columbellopsis*, as is commented on by BOYER AND ROLÁN (2005).

From its form and size it could be included in the genus *Strombina* Mörch, 1852, but the species of this latter genus usually have clear axial sculpture and spiral striations, no present in *M. condei*.

The juvenile shells of *M. condei* may be similar to those of *Strombina descendens* (Martens, 1904) (see below) since this species has 3-5 smooth whorls and a similar pattern of small oval ocelli. They can be differentiated because *S. descendens* have a wider protoconch (about 150-200 µm more); also the suture is shallow in *M. condei* while it is very deep in *S. descendens* and with an evident separation.

Genus *Cotonopsis* Olsson, 1942

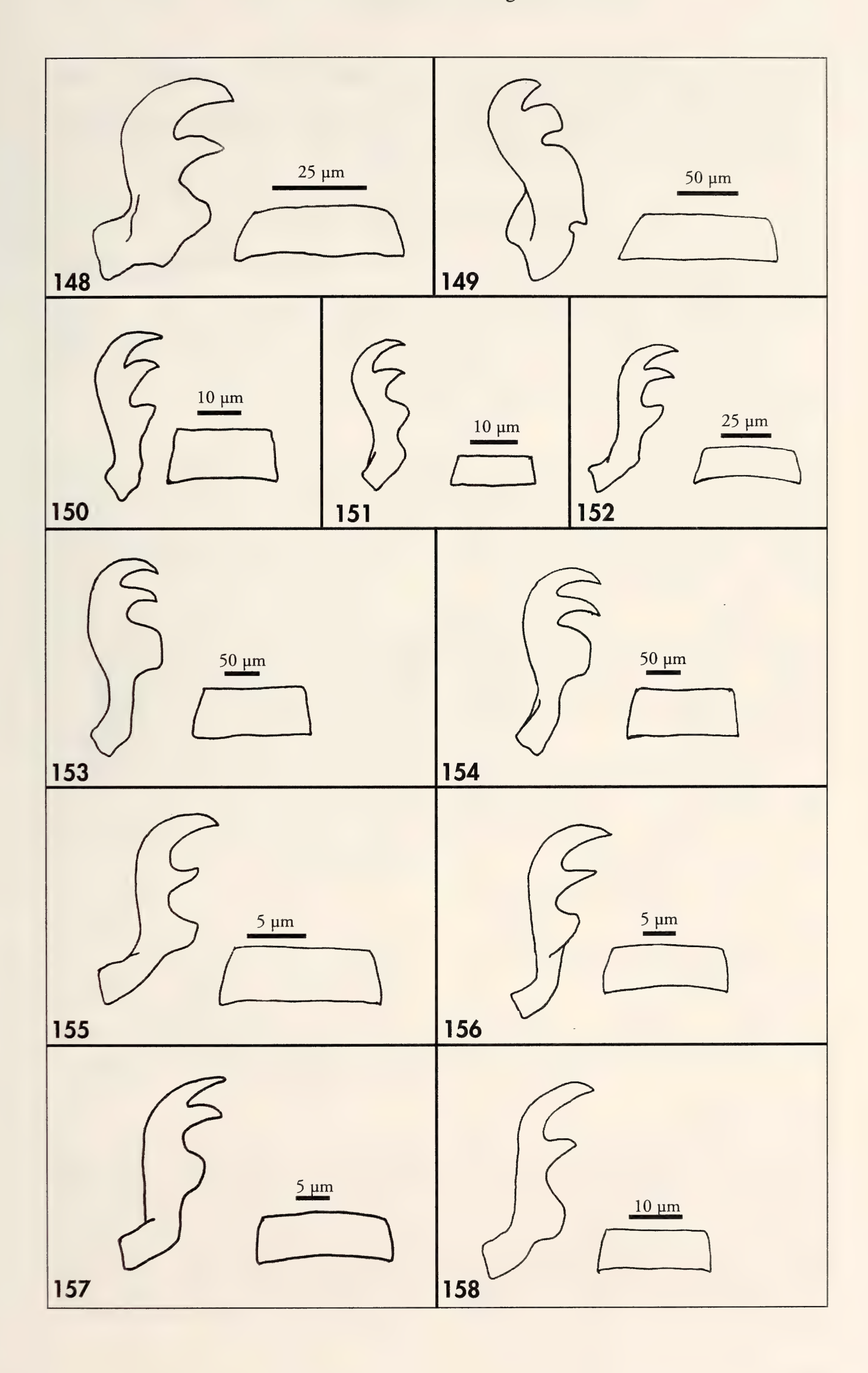
Type species: *Strombina (Cotonopsis) panacostariceus* Olsson, 1942. [Type locality: Pliocene of Burica Peninsula, Costa Rica, Charco Azul Formation]. By original designation.

Cotonopsis monfilsi Emerson, 1993 (Figs. 122, 123)

Cotonopsis monfilsi Emerson, 1993. *The Nautilus*, 106 (4): 147. [Type locality: off St. Louis (16° 02'N 16° 30'W), Senegal, 300 m.]

Type material: Not examined.
Other material examined: Senegal: 2 s, "Louis Sauger" at 600-1000 m (CJH). Guinea Conakry: 3 s, from 40-50 m (CJH); 15 s, Saint Louis, 300-1000 m (MNHN); 3 s, Senegal, 250-300 m (MNHN); Angola: 2 s, from South Angola fishermen (MNHN).

(Right page) Figures 148-158. Radulae of Columbellidae. 148: *Columbella rustica*, Antalya, Turky, shell of 18.6 mm; 149: *Columbella adansoni*, Lanzarote, Canary islands, shell of 19.5 mm; 150: *Anachis valledori*, Sal Rei, Boavista, Cape Verde Is., shell of 6.8 mm; 151: *Mitrella alvarezi*, Sal Rei, Boavista, Cape Verde Islands, shell of 4.0 mm; 152: *Mitrella pallaryi*, Camarinas, Galicia, shell of 14.5 mm; 153: *Mitrella ocellata*, N'gor, Dakar, Senegal, shell of 11.0 mm (decolate); 154: *Mitrella ocellata* albine form, Dakar, Senegal, shell of 11.8 mm (not decolate); 155: *Mitrella broderipi*, Baie de l'Etoile, Nouadhibou, Mauritania, shell of 7.5 mm; 156: *Mitrella psilla*, Sacomar, Angola, shell of 4.0 mm; 157: *Mitrella africana*, Rio Muni, Equatorial Guinea, shell of 8.6 mm; 158: *Mitrella melvilli*, Corimbo, Luanda, shell of 9.5 mm.
(Página derecha) Figuras 148-158. Radulas de Columbellidae. 148: Columbella rustica, *Antalya, Turquía, concha de 18,6 mm; 149:* Columbella adansoni, *Lanzarote, Islas Canarias, concha de 19,5 mm; 150:* Anachis valledori, *Sal Rei, Boavista, Islas de Cabo Verde, concha de 6,8 mm; 151:* Mitrella alvarezi, *Sal Rei, Boavista, Islas de Cabo Verde, concha de 4,0 mm; 152:* Mitrella pallaryi, *Camariñas, Galicia, concha de 14,5 mm; 153:* Mitrella ocellata, *N'gor, Dakar, Senegal, concha de 11,0 mm (decapitada); 154:* Mitrella ocellata *forma albina, Dakar, Senegal, concha de 11,8 mm (no decapitada); 155:* Mitrella broderipi, *Bahía de l'Etoile, Nouadhibou, Mauritania, concha de 7,5 mm; 156:* Mitrella psilla, *Sacomar, Angola, concha de 4,0 mm; 157:* Mitrella africana, *Río Muni, Guinea Ecuatorial, concha de 8,6 mm; 158:* Mitrella melvilli, *Corimbo, Luanda, concha de 9,5 mm.*


25 µm
148
50 µm
149
10 µm
150
10 µm
151
25 µm
152
50 µm
153
50 µm
154
5 µm
155
5 µm
156
5 µm
157
10 µm
158

Description: See EMERSON (1993). We illustrate a typical shell (Figs. 122, 123).

Distribution: It is a species with a wide distribution from Senegal to Angola, mainly found in deep water.

Remarks: No other species is similar to this one.

Genus *Strombina* Mörch, 1852

Type species: *Strombina lanceolata* (G. B. Sowerby, 1832), by subsequent designation Bucquoy, Dautzenberg and Dollfus, 1882, p. 78.
Diagnosis: H. and A. ADAMS (1858: 186), THIELE (1935: 457) and JUNG (1989).

Strombina descendens (Martens, 1904) (Plate 19) (Figs. 124-130)

Mangelia descendens von Martens, 1904. *Ergebn. dtsch. Tiefsee-Exp.*, 7: 7, pl. 3, fig. 20.

Type material: Not examined.
Other material examined: Equatorial Guinea: 4 s, 2 j, St. 45 0° 25′ N, 9° 00′ E (col. Marche-Marchad, MNHN). Gabon: 6 s, Calypso, stn. 451, 0° 25′ N, 09° 00′ E, 73 m (MNHN); 3 s, Port-Gentil, 0° 47.4′ S, 8° 43.6′ E, 25 m (MNHN); 1 s, St. 123, 2° 03.5′ S, 9° 05′ E, (MNHN exZMUC). Congo: 1 s, 3 j, Pointe Noire, Plage Mendame (CPH). Angola: 12 s, Ilha de Luanda, 40-60 m (MNHN); 5 s, Palmeirinhas, Luanda (MNHN); 5 s, Praia Amelia, Namibe, Angola (CER); 8 s, 4 j, Praia Amelia, Namibe, 40-60 m (MNHN).

Description: This species has been described and illustrated in KNUDSEN, (1956: 36, pl. 3, fig. 21), as *Pyrene descendens*. Some specimens are here illustrated (Figs. 124-127) as well as the aperture (Fig. 128).

The protoconch (Figs. 129, 130) is short, but it is difficult to see the whorls since there is no clear separation with the teleoconch; its diameter varies between 750 and 900 µm.

Dimensions: Between 14 and 20 mm.

Soft parts, operculum and radula unknown.

Distribution: Known from Equatorial Guinea to Angola.

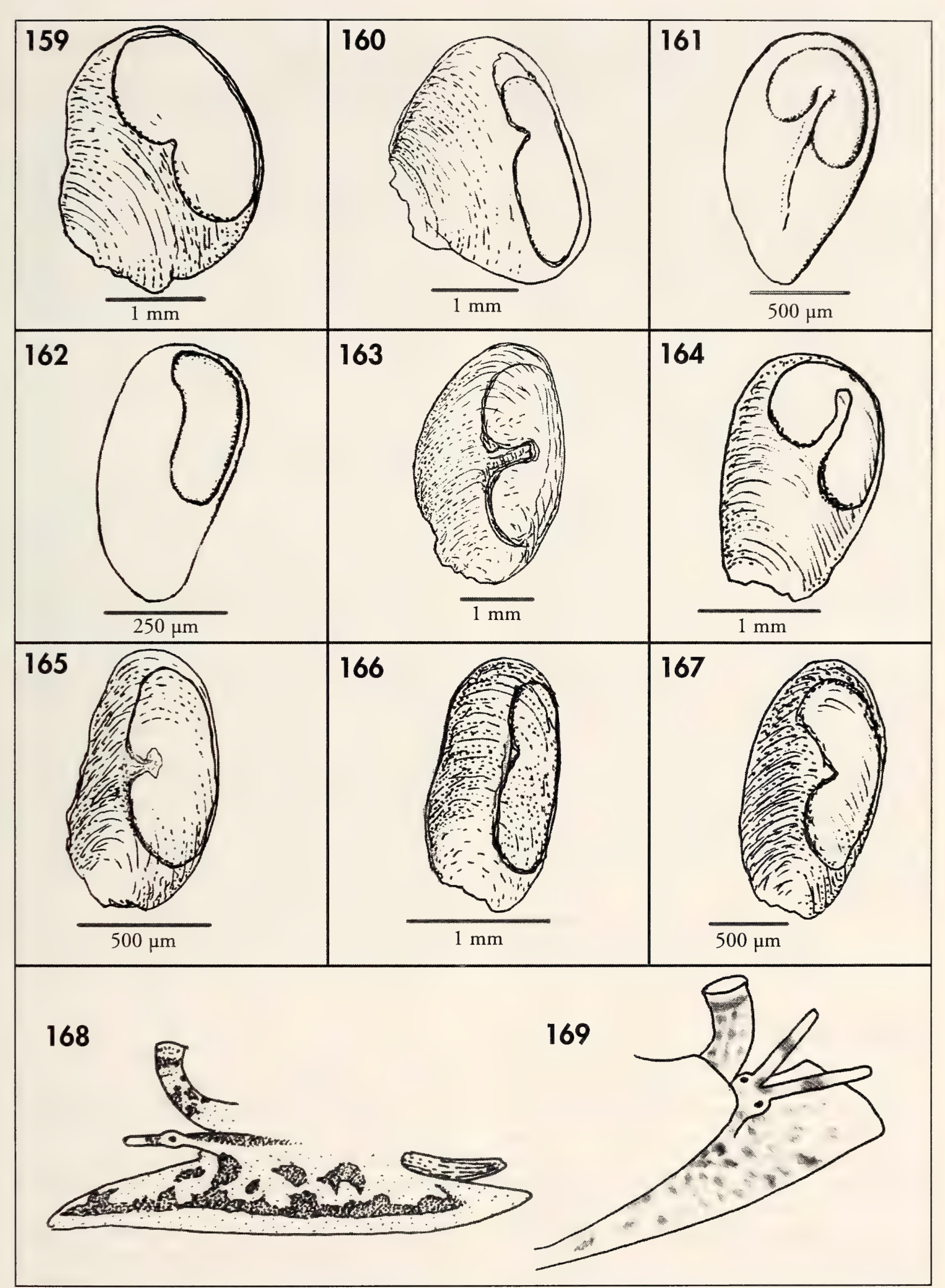
Remarks: The species is tentatively included here in the genus *Strombina* Mörch, 1852 because of its similarity with some West Atlantic and Pacific species of this genus. If further studies prove this relationship, it should be the only known species of this genus in West African.

The specimens from the north of the distribution area (Gabon, Equatorial Guinea) are smaller (usually 10-12 mm) and the dimensions given by KNUDSEN (1956) are about 14 mm. By contrast, the Angolan shells are larger and may reach more than 20 mm.

The comparison of shells from Gabon and Angola, very different in size, did not show other significant differences: the protoconch is slightly smaller, and the smooth whorls may be 1-2 lesser than the Angolan specimens. Anyway, the main characters are equal and we consider them conspecific.

CONCLUSIONS

The family Columbellidae is represented by a high number of species in the Gulf of Guinea, at a similar level to the Mediterranean, where 13 species in 4 genera are known (GIANNUZZI-SAVELLI *ET AL.*, 2003). In the present work we considered 15 species in 5 genera. Of course, if we consider the complete West African area including the species living in the Canary Islands and in Senegal, the total number of species would be notably increased (see SEGERS AND SWINNEN, 2003, HERNANDEZ AND BOYER, 2005, and PELORCE AND BOYER, 2005).



Figures 159-167. Opercula (from the same specimens from which the radula was studied). 159: *C. rustica*; 160: *C. adansoni*; 161: *A. valledori*; 162: *M. alvarezi*; 163: *M. pallaryi*; 164: *M. africana*; 165: *M. psilla*; 166: *M. inesitae*; 167: *M. melvilli*. Figures 168, 169. Soft parts of *Mitrella* species. 168: *M. africana*; 169: *M. psilla*.

Figuras 159-167. Opérculos (de los mismos ejemplares de los que fue estudiada la radula). 159: C. rustica*; 160:* C. adansoni*; 161:* A. valledori*; 162:* M. alvarezi*; 163:* M. pallaryi*; 164:* M. africana*; 165:* M. psilla*; 166:* M. inesitae*; 167:* M. melvilli. *Figuras 168, 169. Partes blandas de especies de* Mitrella. *168:* M. africana*; 169:* M. psilla.

Some of the species studied have a large distribution area (*Columbella adansoni, Mitrella pallaryi, M. psilla, M. melvilli, M. africana* and *C. monfilsi*). Of these species, only one (*M. pallary*) has a very extended area (all the Mediterranean, most of the Macaronesian archipelagos and all West Africa); one other species (*C. adansoni*) extends to the Macaronesian islands besides the West african coast, but not to the Mediterranean. Four more species (*M. psilla, M. melvilli, M. africana* and *C. monfilsi*) have a range approximately equivalent to the extension of the studied area (from Senegal to south Angola).

The single species with a large range which was undescribed is *M. africana*; this species was known but it was considered as part of an American taxon (*M. parvula*).

Some other species have a smaller range (*Strombina descendens*, from Gabon to Angola). The rest of the species has a short range, being probably endemic to small areas of coast (as *Anachis ryalli*, only found in Ghana, and *Mitrella condei*, in Angola); or they are endemic to islands (*M. inesitae, M. saotomensis* and *M. tenebrosa*, endemic in São Tomé, and *M. annobonensis* and *M. aemulata*, in Annobon).

Of these 15 species, 8 are described as new. These species were not known up to now mostly due to their limited distribution area.

The study of the protoconchs showed us that, in spite of the scarce sculpture of most of them, protoconch and nucleus, and even the number of whorls and the colour may be differential characters valid for comparison. The aperture, its form, teeth on the columella and on the outer lip are usually rather constant and also useful for comparison. Radula and operculum also showed differences which may help us to separate species.

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A new *Fusinus* (Gastropoda: Fasciolariidae) from Japan

Un nuevo *Fusinus* (Gastropoda: Fasciolariidae) de Japón

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ABSTRACT

Examination of the holotype of *Fusinus hyphalus* M. Smith, 1940 reveals that *F. hyphalus* is a subjective junior synonym of *F. graciliformis* (Sowerby, 1880). The species often called *F. hyphalus* and illustrated by authors is without a name. *Fusinus satsumaensis* spec. nov. [type locality: off Akune, Kagoshima Prefecture, Japan] is proposed as the name for this misidentified species in the subgenus *Chryseofusus* Hadorn and Fraussen, 2003 and compared with *F. (Chryseofusus) graciliformis* (Sowerby, 1880), *F. (C.) chrysodomoides* (Schepman, 1911), *F. (C.) jurgeni* Hadorn and Fraussen, 2002 and *F. (C.) westralis* Hadorn and Fraussen, 2003.

RESUMEN

El examen del holotipo de *Fusinus hyphalus* M. Smith, 1940 revela que *F. hyphalus* es un sinónimo juvenil de *F. graciliformis* (Sowerby, 1880). La especia a menudo denominada *F. hyphalus* e ilustrada por varios autores carece de nombre. Se propone el nombre de *Fusinus satsumaensis* spec. nov. para esta especie inidentificada, dentro del subgénero *Chryseofusus* Hadorn y Fraussen, 2003. Se compara con *F. (Chryseofusus) graciliformis* (Sowerby, 1880), *F. (C.) chrysodomoides* (Schepman, 1911), *F. (C.) jurgeni* Hadorn y Fraussen, 2002 y *F. (C.) westralis* Hadorn y Fraussen, 2003.

KEY WORDS: Mollusca, Gastropoda, Fasciolariidae, *Fusinus*, *Chryseofusus*, Japan, new species.
PALABRAS CLAVE: Mollusca, Gastropoda, Fasciolariidae, *Fusinus*, *Chryseofusus*, Japón, nueva especie.

INTRODUCTION

Hadorn and Fraussen (2003) recently described the subgenus *Chryseofusus* in *Fusinus* to accommodate a number of species sharing conchological characteristics different from typical *Fusinus* and described new species in this subgenus. One of the treated species was *F. hyphalus* M. Smith, 1940. At that time of that paper the two authors were unable to locate the holotype of *F. hyphalus*.

We have since found the holotype in the Florida Museum of Natural History in Gainesville, USA. Examination of the holotype reveals that *F. hyphalus* is a juvenile specimen of *F. graciliformis*. Based on the original description and the poor figure of the holotype, Hadorn and Fraussen (2003) failed to recognize this synonymy and confused it with the misidentified species often called *F. hyphalus* by authors and

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recorded from Japan, the East China Sea and the Philippine Islands.

Abbreviations used:

ANSP Academy of Natural Sciences, Philadelphia, USA.
BMNH The Natural History Museum, London, United Kingdom.
FLMNH/UF Florida Museum of Natural History, Gainesville, Florida, USA.
MC Collection of Mitsuo Chino, Kawasaki, Japan.
MNHN Muséum national d'Histoire naturelle, Paris, France.
NSMT National Science Museum, Tokyo, Japan.
RH Collection of Roland Hadorn, Lyss, Switzerland.
RMNH National Museum of Natural History – Naturalis, Leiden, the Netherlands.
WAM Western Australian Museum, Perth, Australia.
ZMA Zoologisch Museum, University of Amsterdam, Amsterdam, the Netherlands.
dd dead collected specimen.
juv juvenile specimen.
lv live collected specimen.
subad subadult specimen.

SYSTEMATICS

Family FASCIOLARIIDAE Gray, 1853
Genus *Fusinus* Rafinesque, 1815

Fusinus Rafinesque, 1815. Anal. nat. tabl. univ. corps org.: 145. Substitute name for '*Fusus* Lamarck' [=*Fusus* Bruguière, 1789], non *Fusus* Helbling, 1779.
Type species: *Murex colus* Linnaeus, 1758, by typification of replaced name.

Subgenus *Chryseofusus* Hadorn and Fraussen, 2003

Chryseofusus Hadorn and Fraussen, 2003. The deep-water Indo-Pacific radiation of *Fusinus*. *Iberus*, 21 (1): 207-240.
Type species: *Fusus chrysodomoides* Schepman, 1911.

Fusinus (Chryseofusus) satsumaensis spec. nov. (Figs. 1-8)

Fusinus (Simplicifusus) hyphalus M. Smith, 1940. – Kira (1962: 85); Springsteen and Leobrera (1986: 177+179, pl. 48, fig. 2). non M. Smith, 1940.
Simplicifusus hyphalus (M. Smith, 1940). – Higo, Callomon and Goto (1999: 263). non M. Smith, 1940.
Fusinus (Chryseofusus) hyphalus M. Smith, 1940. – Hadorn and Fraussen (2003: 218-219, figs. 22, 23). non M. Smith, 1940.

Type material: Holotype (78.1 x 24.7 mm, lv), NSMT-Mo 73704: 350-400 m, off Akune, Kagoshima Prefecture, Japan.
Paratype 1 (68.4 x 22.2 mm, lv), MC; paratype 2 (65.9 x 21.3 mm, lv), RH: 350-400 m, off Akune, Kagoshima Prefecture, Japan. Paratype 3 (72.9 x 24.4 mm, lv), MC; paratype 4 (75.9 x 25.1 mm, lv), MNHN; paratype 5 (73.5 x 25.1 mm, lv), ANSP 412950: 250 m, southwest of Cape Noma, Kagoshima Prefecture, Japan.
Other material examined: Japan, from type locality, 1 dd, MC. - Japan, off Cape Noma, Kagoshima Prefecture, 1 dd subad, MC. - Taiwan, deep water, 1 lv juv/1 lv, RH. - Taiwan, Keelung, 1 lv/1 dd subad, RH. - Unknown locality, 1 dd, RH.
Type locality: Off Akune, Kagoshima Prefecture, Japan.
Etymology: *F. (C.) satsumaensis* spec. nov. is named after the type locality. Satsuma is the ancient name of Western Kagoshima which is famous in the Japanese history with regard to the Meiji Restoration 1868.



Figures 1-8. *Fusinus (Chryseofusus) satsumaensis* spec. nov. 1, 2: holotype NSMT-Mo 73704, Japan, off Akune, Kagoshima Prefecture, 78.1 mm; 3,4: paratype MC, Japan, off Akune, Kagoshima Prefecture, 68.4 mm; 5, 6: paratype RH, Japan, off Akune, Kagoshima Prefecture, 65.9 mm; 7: holotype NSMT-Mo 73704, spire tip; 8: Operculum.

Figuras 1-8. Fusinus (Chryseofusus) satsumaensis *spec. nov. 1, 2: holotipo NSMT-Mo 73704, Japón, frente a Akune, Kagoshima Prefecture, 78,1 mm; 3,4: paratipo MC, Japón, frente a Akune, Kagoshima Prefecture, 68,4 mm; 5, 6: paratipo RH, Japón, frente a Akune, Kagoshima Prefecture, 65,9 mm; 7: holotipo NSMT-Mo 73704, ápice de la espira; 8: opérculo.*

Description: Shell rather large for subgenus (up to 80 mm), thin, lightweight but solid, fusiform with elongate spire, uniformly white, pale or light yellow, consisting of about 9 slightly convex whorls with weak subsutural concavity. Spire long and pointed, body whorl inflated and ventricose in adult specimens, siphonal canal narrow, occasionally curved. Aperture including intact siphonal canal slightly longer than spire. Suture fine but distinct, only weakly incised.

Protoconch relatively large, white, glossy, bulbous, consisting of 1 $^1/_4$ - 1 $^1/_2$ whorls, final $^1/_4$ whorl with 3 or 4 narrow axial riblets, reaching from suture to suture. Transition to teleoconch marked by a varix. Diameter 1.1-1.2 mm.

Axial sculpture inconspicuous, only visible on upper teleoconch whorls. Axial ribs weak, narrow, extending from suture to suture, interspaces narrow. 10 or 11 ribs on 3 uppermost teleoconch whorls, up to 15 on fourth whorl, becoming weaker, irregular and disappearing on fourth or fifth whorl. Axial growth lines fine but distinct on all whorls, crossing spiral sculpture and giving the surface the texture of linen.

Spiral sculpture weak. Teleoconch beginning with 5 close-set primary spiral cords. Starting with third whorl, one finer secondary spiral cord appears between each pair of primary cords. From fourth whorl on, fine tertiary spiral threads appear at both sides of the secondary cords. Their number increasing to up to 5 on body whorl, while secondary cords become as strong as the primary ones.

Aperture large, ovate, pointed at both ends, white, smooth inside. Outer lip convex, thin, simple. Inner lip smooth, parietal callus thin, glossy, appressed to parietal wall, not detached, columellar folds absent.

Siphonal canal long, relatively narrow, usually curved, about as long as aperture. Outer side sculptured with fine, close-set spiral cords and intercalated fine threads of different strength.

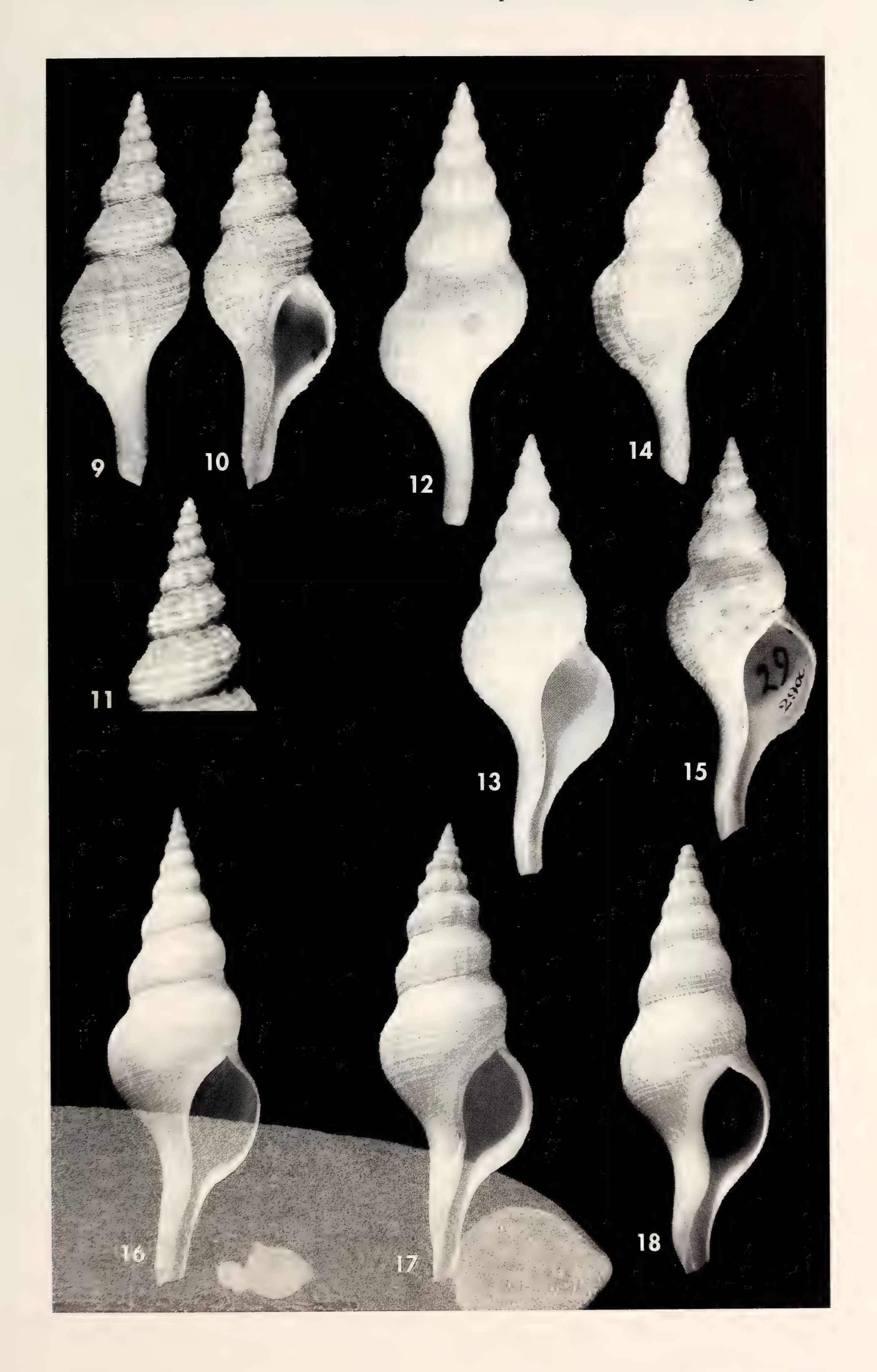
Periostracum thin, well-adherent, straw-brown.

Operculum (Fig. 8) typical of genus, corneous, red-brown, ovate, rounded above and pointed below, shape and size corresponding to aperture, outer side ornamented with concentric growth lines, with terminal nucleus.

Range and habitat: Japan, Enshu-nada and westwards, East China Sea at 100-300 m on sandy bottom (HIGO *ET AL.*, 1999: 263); Taiwan (collection RH), Philippines, Cebu and Bohol (SPRINGSTEEN AND LEOBRERA, 1986: 177).

(Right page) Figures 9-11. *Fusinus (Chryseofusus) hyphalus* M. Smith, 1940, holotype FLMNH/UF 174301, Japan, Shikoku Island, Kochi Prefecture, off Tosa, 36.5 mm. 9, 10: shell; 11: spire tip. Figures 12, 13. *Fusus graciliformis* Sowerby, 1880, holotype BMNH 1880.10.15.2, Japan, 52.5 mm. Figures 14, 15. *Fusus sieboldi* Schepman, 1891, holotype RMNH 86858, Japan, 40.0 mm (=junior synonym of *F. graciliformis*). Figure 16. *Fusinus (Chryseofusus) westralis* Hadorn and Fraussen, 2003, holotype WAM S10876, northwest Australia, Rottnest Island, 114.4 mm. Figure 17. *Fusinus (Chryseofusus) jurgeni* Hadorn and Fraussen, 2002, holotype MNHN, southwest Madagascar, 94.2 mm. Figure 18. *Fusinus (Chryseofusus) chrysodomoides* (Schepman, 1911), lectotype ZMA, Indonesia, Molucca-Passage, 70.7 mm.

(Página derecha) Figuras 9-11. Fusinus (Chryseofusus) hyphalus *M. Smith, 1940, holotipo FLMNH/UF 174301, Japón, isla Shikoku, Kochi Prefecture, frente a Tosa, 36,5 mm. 9, 10: concha; 11: ápice de la espira. Figuras 12, 13.* Fusus graciliformis *Sowerby, 1880, holotipo BMNH 1880.10.15.2, Japón, 52,5 mm. Figuras 14, 15.* Fusus sieboldi *Schepman, 1891, holotipo RMNH 86858, Japón, 40,0 mm (=sinónimo juvenil de* F. graciliformis*). Figura 16.* Fusinus (Chryseofusus) westralis *Hadorn y Fraussen, 2003, holotipo WAM S10876, NO de Australia, isla Rottnest, 114.4 mm. Figura 17.* Fusinus (Chryseofusus) jurgeni *Hadorn y Fraussen, 2002, holotipo MNHN, SO de Madagascar, 94,2 mm. Figura 18.* Fusinus (Chryseofusus) chrysodomoides *(Schepman, 1911), lectotipo ZMA, Indonesia, estrecho de las Molucas, 70,7 mm.*


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Comparison: *F. (C.) satsumaensis* spec. nov. was often misidentified as *F. hyphalus* M. Smith, 1940 by authors, including the paper of *Chryseofusus* by HADORN AND FRAUSSEN (2003). Shortly after publication of that paper the first author was able to locate the holotype of *F. hyphalus* [FLMNH/UF 174301: type locality: Japan, Shikoku Island, Kochi Prefecture, off Tosa, 100 fms, M. Smith's collection] (Figs. 9-11). *F. hyphalus* is a subjective junior synonym of *F. graciliformis* (Sowerby, 1880). This specimen is a dead collected juvenile specimen of 36.5 x 12.5 mm and is identical in shape, sculpture and protoconch structure but somewhat more slender than the holotype of *F. graciliformis* [BMNH 1880.10.15.2, 52.5 x 18.0 mm, dd, type locality: Japan] (Figs. 12, 13) and *F. sieboldi* (Schepman, 1891) [RMNH 86858, 40.0 x 15.2 mm, dd, type locality: Japan (= junior synonym of *F. graciliformis*)] (Figs. 14, 15). Most specimens referred to *F. hyphalus* by authors belong, as far as we are able to determine, to this new species.

The holotype of *F. hyphalus* (Figs. 9-11) differs from the new species by the smaller size, the more convex whorls, the more constricted suture, the reddish-brown coloured shell, and the smaller protoconch (diameter 0.8 mm instead of 1.1-1.2 mm). In general, *F. (C.) graciliformis* can be separated by the somewhat larger adult size, the deeper and more pronounced subsutural concavity, the less inflated and shorter body whorl, the clearly smaller and differently sculptured protoconch, and by often having rather strong, broad axial ribs on the upper whorls.

F. (C.) westralis Hadorn and Fraussen, 2003 (Fig. 16) differs by its larger shell (up to 140 mm), the longer spire, the larger number of whorls (11-13), the more pronounced subsutural concavity, the finer spiral sculpture consisting of a larger number of fine spiral cords and intercalated threads, and the shorter and broader siphonal canal.

F. (C.) jurgeni Hadorn and Fraussen, 2002 (Fig. 17) can be distinguished by its larger shell (up to 100 mm), the longer spire, the more numerous (11 or 12) and more convex whorls, the more constricted suture, the wider spire angle, the stronger spiral sculpture, the often reddish-brown tinged spiral cords, the stronger and broader axial ribs on upper teleoconch whorls, the more rounded aperture and the broader siphonal canal.

F. (C.) chrysodomoides (Schepman, 1911) is similar in size, but differs by having a longer spire, a heavier shell, a larger number of whorls, a wider spire angle, a more pronounced axial sculpture on the upper whorls, a smaller and more rounded aperture, and a shorter and broader siphonal canal. The lectotype designated by HADORN AND FRAUSSEN (2003: 211) is figured here (Fig. 18).

F. satsumaensis is placed in the subgenus *Chryseofusus* based on the smooth adapical whorls, the weak, close-set, regular spiral sculpture crossed by distinct growth lines, giving the surface the texture of linen, the relatively short spire and siphonal canal, the less convex whorls with subsutural concavity, and the simple, thin, adherent parietal callus.

F. satsumaensis was, as misidentified as *F. hyphalus*, often placed in the genus *Simplicifusus* Kuroda and Habe in Kuroda, Habe and Oyama, 1971 [type species: *Simplicifusus noguchii* Habe and Masuda, 1990]. *Simplicifusus* was concluded to be a subjective junior synonym of *Granulifusus* by SNYDER (2003: 87-88). *Granulifusus* has an operculum which is completely different from all other species belonging to the subgenus *Chryseofusus* and all other subgenera in *Fusinus*. Species of the genus *Fusinus* have an operculum with terminal nucleus, corresponding to the aperture in size and shape. *Granulifusus* has a small, round-ovate, thin operculum, not filling the aperture, with nucleus situated at lower outer side. For a detailed discussion we refer to HADORN AND FRAUSSEN (2003: 211) and to SNYDER (2003: 88).

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Checklist of the opisthobranchs (Mollusca: Gastropoda) from the Chilean coast deposited in the "Colección de Flora y Fauna Profesor Patricio Sánchez Reyes" from the "Pontificia Universidad Católica de Chile"

Catálogo de los opistobranquios (Mollusca: Gastropoda) de la costa Chilena depositados en la "Colección de Flora y Fauna Profesor Patricio Sánchez Reyes" de la Pontificia Universidad Católica de Chile

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ABSTRACT

The specimens of opisthobranch molluscs included in the "Colección de Flora y Fauna Profesor Patricio Sánchez Reyes", housed in the Pontificia Universidad Catolica de Chile have been examined. As result of this review, a checklist of 18 opisthobranch species (2 sacoglossans, 1 pleurobranchid and 15 nudibranchs) is given.

To date, a total of 75 opisthobranch species, arranged in 51 genera and 34 families, have been recorded in Chile. In this paper, the geographical distribution of the studied species is commented on and extended in some cases.

RESUMEN

Se han revisado los ejemplares de moluscos opistobranquios presentes en la "Colección de Flora y Fauna Profesor Patricio Sánchez Reyes", depositada en la Pontificia Universidad Católica de Chile. Como resultado de dicha revisión, se presenta una lista de 18 especies de opistobranquios (2 sacoglosos, 1 pleurobránquido y 15 nudibranquios).

Hasta el momento, en Chile se han citado un total de 76 especies de opistobranquios, distribuídas en 51 géneros y 34 familias. En el presente trabajo se comenta y se amplía en algunos casos la distribución geográfica de las especies abordadas.

KEY WORDS: Opisthobranchia, Sacoglossa, Nudipleura, Pleurobranchoidea, Nudibranchia, Chilean coast.
PALABRAS CLAVE: Opisthobranchia, Sacoglossa, Nudipleura, Pleurobranchoidea, Nudibranchia, costa Chilena.

INTRODUCTION

Information on the opisthobranch molluscs from the Chilean coast goes back to records in the nineteenth century and originates mainly from scientific expeditions of European origin and one of North-American origin,

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Table I. Main scientific expeditions in which opisthobranch species from the Chilean coast were collected.
Tabla I. Principales expediciones en las que se recolectaron opistobranquios en las costas chilenas.

Expedition	Country	Years	Author
Voyage autour du monde sur la corvette *La Coquille*	France	1822-1825	Lesson (1831)
Voyage dans l'Amérique Méridionale	France	1826-1833	d'Orbigny (1835-1846)
Voyage de *l'Astrolabe*	France	1826-1829	Quoy and Gaimard (1832)
The Vogage of HMS *Challenger*	Denmark	1873-1876	Bergh (1884)
Mission Scientifique du Cap Horn	France	1882-1883	Rochebrune and Mabille (1891)
Albatross	U.S.A.	1885-1888	Dall (1890)
Expedition of 2 years to the west coast of South America	Denmark	1893-1895	Bergh (1898a)
Swedish Antarctic Expedition	Sweden	1901-1903	Odhner (1926)
Expedition Natural History	Great Britain	1901-1904	Eliot (1907)
Expedition to Juan Fernández and Eastern Island	Sweden	1921	Odhner (1921)
The Lund University Chile Expedition	Sweden	1948-1949	Marcus (1959)

which also yielded general collections of various taxonomic groups.

The results of these expeditions have been published as checklists and descriptions of molluscs in various journals and books, including descriptions of about 60 species, several of which were described for the first time (see Table I). Other publications not specifically devoted to opisthobranch molluscs but dealing with some Chilean species are Pöppig (1829), Gould (1852), Cunningham (1871), Abraham (1877), Pfeffer (1886), Dall (1889; 1909), Plate (1894), Pilsbry (1895), Strebel (1905), Powell (1951) and Rehder (1980).

The opisthobranchs of South-America need a detailed revision, because until now most species have been described on the basis of preserved material, sometimes with a single reference specimen, and in many cases only as to their external morphology. Moreover, many of these descriptions are fragmentary or ambiguous.

In recent years, interest in the opistobranch molluscs of South-America has revived, and several faunistic and taxonomic studies have been published, mostly based on the study of living material and mainly concerning opisthobranch species of the Chilean coast (Millen, Schrödl, Vargas and Indacochea, 1994; Schrödl, 1996a; b, 1997a; b; c, 1999a; b; c, 2000a; b; c, 2001, 2003; Muñoz, Valdés and Ortea, 1996; Fischer and Ortea, 1997; Fischer, Cervera and Ortea, 1997; Valdés and Gosliner, 2001; Valdés, 2002; Valdés and Muniaín, 2002; Fischer and Cervera, 2005; Fischer, van der Velde and Roubos, 2005; Schrödl, Alarcón, Bedriñana, Bravo, Bustamante, Carvalho, Försterra, Gallardo, Häussermann and Salmen, 2005).

Some of the species reported for the Chilean coast have also been recorded from the Antarctic coast (Wägele, 1990; 1995; Cattaneo-Vieti, 1991; García, Troncoso, García-Gómez and Cervera, 1993) and from Argentina (Muniaín, Ortea and Rodríguez, 1991; Muniaín, Valdés and Ortea, 1996; Schrödl, 1996b) and Peru (d'Orbigny, 1837; Millen *et al.*, 1994; Schrödl, 1996b).

In 1960 Professor Patricio Sánchez Reyes, from the Pontificia Universidad Católica de Chile, in Santiago de Chile, founded the Room for Systematics ("la Sala de Sistemática") where biological material collected from several field expeditions was deposited. After his decease in 1999, and in recognition of his exhaustive work, this systematic room was named "Colección de Flora y Fauna Profesor Patricio Sánchez Reyes".

In this paper we study the opisthobranch material gathered from the Chilean coast between 1960 and 1971, present in this institution. It has not been studied until now, due to a lack of Chilean specialists.

MATERIAL AND METHODS

Specimens were identified by studying their external morphology as well as their anatomy. Results were compared with descriptions in the literature. Information about the collection localities of the material along the Chilean coast and the geographic distribution of the species has been included.

The classification follows recent and comprehensive studies of the phylogeny of various opisthobranch groups (JENSEN, 1996, 1997; WÄGELE AND WILLAN, 2000; SCHRÖDL, WÄGELE, AND WILLAN, 2001; VALDÉS AND GOSLINER, 2001; VALDÉS, 2002). According to modern insights in phylogenetic classification, taxa higher than 'family' have been not assigned to a taxonomic category (DE QUEIROZ AND GAUTHIER, 1994) but the hierarchical structure of the classification has been maintained.

RESULTS

Opisthobranchs of the Chilean coast are distributed over five higher taxa according to the new classifications: Cephalaspidea, Aplysiomorpha, Sacoglossa, Tylodinoidea and Nudipleura (see Table II). Among our material, we only identified species belonging to Sacoglossa and Nudipleura, as will be described in the following list.

OPISTHOBRANCHIA
SACOGLOSSA Von Ihering, 1876
Family PLAKOBRANCHIIDAE Gray, 1840
Genus *Elysia* Risso, 1818

Elysia hedgpethi Marcus, 1961

Material: Los Molles (32° 15′ S; 71° 30′ W), four specimens (N° SSUC-729). Duao, X región (34° 55′ S; 71° 33′ W), one specimen (N° SSUC-612).

Previous records from Chile: SCHRÖDL (1996a): Seno Otway (53° 07′ S; 71° 22′ W), Fuerte Bulnes (53° 39′ S; 70° 56′ W), Bay of Mansa (53° 32′ S; 70° 55′ W) in the South of Chile. The present material is the first record from the central coast of Chile.

General distribution: Also known from Tomales Bay (California) (MARCUS, 1961) and from Vancouver Island (MILLEN, 1980) to Bahía de los Angeles and Bahía de San Quintín (Baja California, Mexico) (BEHRENS, 1991).

Family HERMAEIDAE H. Adams and A. Adams, 1854
Genus *Aplysiopsis* Deshayes, 1839/1853 non Bergh, 1872

Aplysiopsis brattströmi Marcus, 1959

Material: La Portada, Bay of Antofagasta (23° 38′ S; 70° 31′ W), one specimen (N° SSUC-2608).

Previous records from Chile: Marcus (1959): Antofagasta (type locality); SCHRÖDL (1996a) recorded this species from the central and southern Chilean coast: Bay of

Coliumo (36° 32′ S; 72° 57′ W), Fuerte Bulnes, extending its geographic distribution significantly towards the south.

General distribution: Also known from Comodoro Rivadavia, Patagonia Argentina (MUNIAÍN, 1997).

NUDIPLEURA Wägele and Willan, 2000
PLEUROBRANCHOIDEA Férussac, 1822
Family PLEUROBRANCHIDAE Férussac, 1822
Genus *Berthella* Blainville, 1824

Berthella platei (Bergh, 1898)

Material: Los Molles, two specimens (N° SSUC-183). Poza Arrecifes, Los Molles, one specimen, (N° SSUC-470). El Tabo (33° 27′ S; 71° 38′ W), one specimen (N° SSUC-32).

Previous records from Chile: BERGH (1898a): Quirina; ODHNER (1926): Gulf of Reloncaví (41° 44′ S; 72° 55′ W), Punta Pelluco (41° 30′ S; 72° 53′ W), North from Bay of Quellín (41° 51′ S; 72° 55′ W), South from Gulf of Ancud (42° 26′ S; 72° 59′ W); BurdwoodBank (53° 45′ S; 61° 10′ W); MARCUS (1959): Bay of Calbuco (41° 56′ S; 73° 08′ W), North from Gulf of Ancud, between Tres Cruces and Punta Piedras (41° 50′ S; 73° 28′ W); SCHRÖDL (1999): Island Picton, Beagle Channel, Lenca, Bay of Reloncaví; SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W).

General distribution: This species has not been reported outside the Chilean coast.

NUDIBRANCHIA Blainville, 1814
Family POLYCERIDAE Alder and Hancock, 1845
Genus *Thecacera* Fleming, 1828

Thecacera darwini Pruvot-Fol, 1950

Material: Coliumo, Los Morros (36° 29′ S; 72° 58′ W), three specimens (N° SSUC-1102), three specimens (N° SSUC-1109). Caleta Leandro, Tumbes (36° 37′ S; 73° 07′ W), two specimens (N° SSUC-1538).

Previous records from Chile: PRUVOT-FOL (1950): Bay of Naranja, Islote Hoste (55° 10′ S; 69° 20′ W); MARCUS (1959): Chiloé-North, Punta Ahui (41° 49′ S; 73° 51′ W), Islote de Chonos (45° 00′ S; 74° 00′ W); SCHRÖDL (1996a; 2003): Juan López (23° 30′ S; 70° 32′ W), Bay Inglesa (27° 07′ S; 70° 53′ W), Los Hornos, Coquimbo (29° 38′ S; 71° 29′ W), Pichidangui (32° 08′ S; 71° 33′ W), Bay of Coliumo; SCHRÖDL (2003): Seno Ventisquero (44° 30′ S; 72° 35′ W); SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W); FISCHER *ET AL.* (2005): Bay of Antofagasta (23° 29′ S; 70° 25′ W), Bay of La Herradura (29° 58′ S; 71° 22′ W), Bay Tongoy, Coquimbo (30° 15′ S; 71° 30′ W), Bay Horcón, Valparaíso (33° S; 71° W); Las Cruces, Valparaíso (33° 29′ S; 71° 38′ W); Bay Hueihue, Ancud, Chiloé (41° 54′ S; 73° 31′ W); Bay Putemún, Castro, Chiloé (42° 25′ S; 73° 45′ W).

General distribution: This species has not been recorded outside the Chilean coast.

Family Chromodorididae Bergh, 1891
Genus *Cadlina* Bergh, 1878

Cadlina sparsa (Odhner, 1922)

Material: Coliumo, Los Morros, one specimen, 29 mm in length (N° SSUC-1102).

Previous records from Chile: ODHNER (1922): Archipelago of Juan Fernández (33° 37′ S, 78° 53′ W); MARCUS (1959): Bay of Quetalmahue (41° 50′ 40′ S; 73° 57′ 10′ W); SCHRÖDL (1996a; 2003): Bay of Coliumo; SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W).

General distribution: This species is also known from California (JAECKLE, 1984; BEHRENS, 1991) and Argentina (SCHRÖDL, 2000b, 2003).

Genus *Tyrinna* Bergh, 1898

Tyrinna nobilis Bergh, 1898

Material: Iquique (20° 12′ S; 70° 10′ W), two specimens (N° SSUC-3334).

Previous records from Chile: BERGH (1898a), ODHNER (1921): Juan Fernández Island; Pajargo Island (probably Pájaros Island); MARCUS (1959): Strait of Chacao (41° 46′ S; 73° 45′ W), Punta de Tenaún (42° 20′ 50″ S; 73° 22′ 00″ W) and Bay of Calbuco; SCHRÖDL (1996a): Bay of Coliumo, Faro Corona (41° 50′ S; 73° 50′ W), Seno Ventisquero (44° 30′ S; 72° 35′ W); SCHRÖDL AND MILLEN (2001): Beach Los Piqueros (26° 12′ S; 70° 39′ W), Los Hornos, Pichidangui (32° 08′ S; 71° 33′ W), Bay of Coliumo, Lenca (41° 40′ S; 72° 40′ W); SCHRÖDL (2003): Strait of Magellan, Chilean Patagonia to Los Hornos (northern Chile) and Juan Fernández Islands; SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W).

General distribution: This species is also known from several localities in Argentinian Patagonia (MUNIAÍN *ET AL.*, 1996; SCHRÖDL, 1996a, 2003; SCHRÖDL AND MILLEN, 2001).

Family DORIDIDAE Rafinesque, 1815

Genus *Doris* Linnaeus, 1758

Doris fontainei d'Orbigny, 1837

Material: Mehuín (39° 26′ S; 73° 12′ W), one specimen (N° SSUC-2129). Poza Verde, Coliumo, one specimen (N° SSUC-1141). Punta Moquehua, Caleta Mansa, five specimens (No. SSUC-5313). Chiloé (43° 00′ S; 74° 00′ W), one specimen (N° SSUC-5411).

Previous records from Chile: D'ORBIGNY (1835-1846): Southern Montemar, northern of Valparaíso (32° 57′ 24″ S; 71° 33′ 25″ W); ODHNER (1926): Coquimbo, Puerto Montt (41° 28′ S; 72° 57′ W) and Dichato (36° 33′ S; 72° 56′ W); MARCUS (1959): Los Molles; SCHRÖDL (1996a): Bay of Coliumo, Seno Ventisquero. SCHRÖDL (2003): from Chilean Patagonia to Arica (northernmost of Chile) (18° 25′ S; 70° 16′ W); SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W).

General distribution: Also known from Argentina: Northern Argentina (ODHNER, 1926); and Patagonian shores (SCHRÖDL, 1996a; VALDÉS AND MUNIAÍN, 2002). Moreover, SCHRÖDL (2003) supports its presence in the Peruvian coast.

Remarks: *Doris fontainei* has been recently reported from the coasts of Argentina and Chile under different names (MUNIAÍN *ET AL.*, 1991; SCHRÖDL, 1996a; 1997b; 2000c). But, according to VALDÉS AND MUNIAÍN (2002), the correct specific name for this species should be *D. fontainei*. Recently. SCHRÖDL (2003) transferred this species to the genus *Archidoris* based on the absence of an acrembolic penis as described for the

Table II. Opisthobranch species recorded from the Chilean coast. Taxa higher to Family level are not assigned to any category, as explained in the text. Species included in our material are marked with an asterisk.

Higher Taxa	Families	Genera	Species
CEPHALASPIDEA *S.L*[1]	Acteonidae	*Actaeon*	*A. delicatus* Dall, 1889
			A. curtulus Dall, 1889
			A. vagabundus Rochebrune and Mabille, 1891
	Diaphanidae	*Diaphana*	*D. paessleri* Strebel, 1905
		Toledonia	*T. limnaeaeformis* (Smith, 1879)
			T. perplexa Dall, 1902
	Scaphandridae	*Scaphander*	*S. interruptus* Dall, 1890
	Aglajidae	*Aglaja*	*A. maculata* (d'Orbigny, 1837)
APLYSIOMORPHA	Aplysiidae	*Aplysia*	*A. parvula* Bergh, 1898
		Dolabella	*D. auricularia* (Lightfoot, 1786)
	Dolabriferidae	*Dolabrifera*	*D. dolabrifera* (Rang, 1828)
SACOGLOSSA			
Oxynoacea	Juliidae	*Julia*	*J. exquisita* Gould, 1862
		Berthelinia	*B. pseudochloris* Kay, 1964
Plakobranchacea	Plakobranchidae	*Elysia*	**E. hedgpethi* Marcus, 1961
	Hermaeidae	*Aplysiopsis*	**A. brattströmi* Marcus, 1959
	Limapontidae	*Limapontia*	*Limapontia* sp.
		Ercolania	*E. evelinae* Marcus, 1959
TYLODINOIDEA	Umbraculidae	*Umbraculum*	*U. umbraculum* (Lightfoot, 1786)
NUDIPLEURA			
Pleurobranchoidea [2]	Pleurobranchidae	*Berthella*	**B. platei* (Bergh, 1898)
		Berthellina	*B. citrina* (Rüppel and Leuckart, 1828)
		Pleurobranchaea	*P. maculata* (Quoy and Gaimard, 1832)
Nudibranchia			
Anthobranchia			
Doridoidea			
"Phanerobranchia" [3]	Onchidorididae	*Acanthodoris*	*A. falklandica* Eliot, 1907
	Goniodorididae	*Okenia*	*O. angelensis* Lance, 1966
			O. luna Millen, Schrödl, Vargas and Indacochea, 1994
		Ancula	*A. fuegiensis* Odhner, 1926
	Corambidae [4]	*Corambe*	*C. lucea* Marcus, 1959
	Polyceridae	*Kaloplocamus*	*K. maculatus* (Bergh, 1898)
		Holoplocamus	*H. papposus* Odhner, 1926
		Polycera	*P. priva* Marcus, 1959
			P. alabe Collier and Farmer, 1964
		Thecacera	**T. darwini* Pruvot-Fol, 1950
Cryptobranchia	Chromodorididae [5]	*Cadlina*	**C. sparsa* (Odhner, 1922)
		Tyrinna	**T. nobilis* Bergh, 1898
	Dorididae	*Doris / Neodoris*	**D. fontainei* d'Orbigny, 1837
			**D. kerguelenensis* (Bergh, 1884)
			Doris sp. 1
			N. claurina Marcus, 1959 *incertae sedis*
	Discodorididae [6]	*Geitodoris*	*G. patagonica* Odhner, 1926
		Baptodoris	**B. peruviana* (d'Orbigny, 1837)
		Gargamella	**G. inmaculata* Bergh 1894
		Diaulula	*D. hispida* (d'Orbigny, 1837)
			**D. punctuolata* (d'Orbigny, 1837)
			**D. variolata* (d'Orbigny, 1837)
		Rostanga	**R. pulchra* MacFarland, 1905

Tabla II. Opistobranquios citados en la costa chilena. No se asignan taxones a categorias superiores a familia, tal y como se explica en el texto. Las especies incluidas en nuestro material se indican con un asterisco.

Higher Taxa	Families	Genera	Species
Dexiarchia [7]			
Cladobranchia			
Dedronotoidea	Tritoniidae	*Tritonia*	*T. challengeriana* Bergh, 1884
			T. vorax (Odhner, 1926)
			**T. odhneri* Marcus, 1959
			Tritonia sp. 1
	Dendronotoidae	*Dentronotus*	*Dendronotus* sp.
	Dotoidae	*Doto*	**D. uva* Marcus, 1955
	Hancockidae	*Hankockia*	*H. schoeferti* Schrödl, 1999
	Phylliroidae	*Phylliroe*	*P. bucephala* Pèron and Lesueur, 1810
Arminoidea	Arminidae	*Armina*	*A. cuvieri* (d'Orbigny, 1837)
	Proctonotidae	*Janolus* [8]	*J. rebeccae* Schrödl, 1996
			J. chilensis Fischer, Cervera and Ortea, 1997
Aeolidoidea	Flabellinidae	*Flabellina*	*F. falklandica* Eliot, 1907
			Flabellina sp. 1
			Flabellina sp. 2
	Tergipedidae	*Cuthona*	*C. georgiana* (Pfeffer in Martens and Pfeffer, 1886)
			C. pusilla (Bergh, 1898)
			C. odhneri Marcus, 1959
			C. valentini (Eliot, 1907)
			Cuthona sp. 1
			Cuthona sp. 2
	Eubranchidae	*Eubranchus*	*E. agrius* Marcus, 1959
			Eubranchus sp. 1
			Eubranchus sp. 2
	Tergipedidae	*Tergipes*	*T. valentini* (Eliot, 1907)
	Facelinidae	*Facelina*	*F. cyanella* (Couthouy in Gould, 1852) *insertae sedis*
		Phidiana	**P. lottini* (Lesson, 1831)
			P. patagonica (d'Orbigny, 1837)
	Glaucidae	*Glaucus*	*G. atlanticus* Forster, 1777
	Aeolidiidae	*Aeolidia*	**A. papillosa* (Linnaeus, 1761)
			A. collaris Odhner, 1922
	Fionidae	*Fiona*	**F. pinnata* (Eschscholtz, 1831)

[1] In view of the analyses of MIKKELSEN (1996; 2002) and the molecular analyses of GRANDE, TEMPLADO, CERVERA AND ZARDOYA (2004a; b) it seems clear that this taxon is paraphyletic, although we used it in the present study because the phylogenetic relations between the different groups are still not definitively established.

[2] There are three species of Pleurobranchoidea reported from Chile, but only *Berthella platei* is reported in this study, and is the only one occurring in both the Magellan and Peruvian provinces. Two other pleurobranchid species, *Berthellina citrina* (Rüppell and Leuckart, 1828) and *Pleurobranchaea maculata* (Quoy and Gaimard, 1823) have been recorded from the Chilean coast, but they are restricted to Easter Island and the Juan Fernández Islands, respectively. However, both records should be considered very doubtful according to MARCUS AND GOSLINER (1984), SCHRÖDL (1996a) and CERVERA, GOSLINER AND GARCÍA-GÓMEZ (1999).

[3] Recent studies support the non-monophyly of Phanerobranchia (THOLLESSON, 1999; WOLLSCHEID AND WÄGELE, 1999; WOLLSCHEID-LENGELING, BOORE, BROWN AND WÄGELE, 2001; VALDÉS, 2002; WÄGELE, VONNEMANN AND WÄGELE, 2003; GRANDE, TEMPLADO, CERVERA AND ZARDOYA, 2004a, b; FAHEY AND GOSLINER, 2004) although a deep phylogenetic analysis of this taxon is still lacking.

[4] SCHRÖDL AND WÄGELE (2001) have recently clarified the systematic position of the Family Corambidae and redescribe the Chilean species *Corambe lucea* Marcus, 1959.

Table II. Continuation.
Tabla II. Continuación.

[5] In Chile the Chromodorididae are represented by two genera, each one with one species: *Cadlina sparsa* and *Tyrinna nobilis*. Another nominal chromodoridid species, *Chromodoris juvenca* Bergh, 1898 was attributed to the genus *Cadlina* by Marcus (1959) and Schrödl (1996a). However, this species is currently considered as a junior synonym of *T. nobilis* (Schrödl, 2000b, 2003; Schrödl and Millen, 2001). Thus, the only valid species of *Cadlina* in Chile appears to be *C. sparsa*.

[6] After the recent revision and phylogenetic study of the dorid criptobranchs Valdés (2002) considered the Families Platydorididae, Baptodorididae and Diaululidae as synonyms of the Family Discodorididae. Consequently, the genera *Baptodoris*, *Gargamella* and *Diaulula* must be included within the family Discodorididae.

[7] Dexiarchia Schrödl, Wägele and Willan, 2001 is a Nudibranchia clade recently erected, which includes the Doridoxoidea, Dendronotoidea, Aeolidoidea and Arminoidea.

[8] There are two valid species at the Chilean coast, *Janolus rebeccae* Schrödl, 1996 and *J. chilensis* Fischer, Cervera and Ortea, 1997. A posterior comparative study of both species let us see that they are different species (Fischer, Schrödl and Cervera, unpublished data).

genus *Doris*. In the genus *Archidoris* the prostate gland is reduced or absent, whereas in *Doris fontainei* it is well developed, which agrees with the genus *Doris* in general. Nevertheless, in this study, we consider that based on most of the morphological characters it belongs to the genus *Doris*.

Doris kerguelenensis (Bergh, 1884)

Material: Island Nueva, Magallanes (55° 15′ S; 66° 32′ W), one specimen (N° SSUC-5155).

Previous records from Chile: Bergh (1884): Puerto Otway (Chilean Patagonia); Bergh (1898a): Bay Tumbes and Punta Arenas; Odhner (1926): Punta Arenas, Puerto Sofía, River Condor, Tierra del Fuego, Puerto Harris; Marcus, 1985: 61° 15′ S; 55° 05′ W; Schrödl (1996a): Bay Posesión (52° 13′ S; 69° 17′ W).

Distribution: Also known from Royal Sound and Morbihan Bay, Kerguelen Islands (Bergh, 1884; Vicente, 1974); Almirante Buck, Antartic Territory (Vayssière, 1917); South Georgias, South from Falklands Islands, Ushuaia (Argentina) (Odhner, 1926); McMurdo Sound, Antarctic Territory (Odhner, 1934); Davis Sea, Antarctic Territory (Minichev, 1972); Macquarie and Heard Islands (Burn, 1973); Scotia Sea (García et al., 1993); Wedell Sea, Antarctic Peninsula and South Georgias (Wägele, 1990); New Caledonia (Valdés, 2001).

Remarks: Valdés (2002) has argued that *Austrodoris* is synonymous with *Doris*. Accordingly, the species *Austrodoris kerguelenensis* should be denominated *Doris kerguelenensis* and be included within the Dorididae, as was also suggested by Schrödl (1996a). Recently, however, Schrödl (2003) referred to this species as *Austrodoris kerguelenensis* overlooking the statement of Valdés (2002).

Family Discodorididae Bergh, 1891
Genus *Baptodoris* Bergh, 1884

Baptodoris peruviana (d'Orbigny, 1837)

Material: Iquique (20° 12′ S; 70° 10′ W), three specimens (N° SSUC-3332). La Portada, Antofagasta, three specimens (N° SSUC-2607). South-East of the Mejillones Peninsula (23° 20′ S; 70° 34′ W), twelve specimens, (N° SSUC-3032). Los Molles, three specimens (N° SSUC-183).

Previous records from Chile: Isla Pájaros (BERGH, 1898); Valparaíso, (DALL, 1909).

General distribution: This species is also known from Peru: San Lorenzo (D'ORBIGNY, 1837) to Pucasana (SCHRÖDL, 1996a). Its record from Galápagos Islands (PILSBRY AND VANATTA, 1902) has been considered dubious (FISCHER AND CERVERA, 2005) and not considered here.

Remarks: The nominal species *Doris peruviana* d'Orbigny, 1837 was transferred to the genus *Platydoris* by Schrödl (2003), considering *P. punctatella* Bergh, 1898 as a junior synonym. DORGAN, VALDÉS AND GOSLINER (2002) were not able to assign a generic name to *P. punctatella* on the basis of the original description by BERGH (1898), but using the photograph of a living animal in SCHRÖDL (1996a), they stated that it is not a *Platydoris* species. FISCHER AND CERVERA (2005) agree with this view. Thus, since the type material of *D. peruviana* cannot be located, these authors compare specimens of a doridoidean species from Iquique to Los Molles (Chilean coast) with the holotype of *P. punctatella*, and conclude that both are conspecific and, according to the radular teeth features, belong to the genus *Baptodoris* rather than *Platydoris*.

Genus *Gargamella* Bergh, 1894

Gargamella inmaculata Bergh, 1894

Material: Cabo Metalqui, Chiloé (41° 50′ 30″ S; 73° 28′ 30″ W), two specimens (N° SSUC-3899).

Previous records from Chile: ODHNER (1926): Ultima Esperanza, Tierra del Fuego (53° 00′ S; 69° 20′ W); MARCUS (1959): Cabo de San Antonio (53° 55′ S; 70° 52′ W), Cabo Delgado (50° 06′ S; 74° 55′ W), Gulf of Ancud, between Quenu and Islote de Calbuco (41° 48′ 50″ S, 73° 09′ 40″ W); SCHRÖDL (1996a): Seno Otway, Queule (39° 23′ S; 73° 13′ W), Bay of Coliumo. This is a common species from the southern Chilean coast.

General distribution: Also recorded from Northern Argentina (BERGH, 1894; ODHNER, 1926), as well as the Argentinian Patagonia and the Burdwood Bank (ODHNER, 1926; SCHRÖDL, 2003). The records from Peru, Southern Africa and New Zealand by ZAGAL AND HERMOSILLA (2001) are considered erroneous (SCHRÖDL, 2003).

Remarks: SCHRÖDL (1996a) included this species erroneously in the family Kentrodorididae, but recently VALDÉS (2002) transferred it again to the family Discodorididae.

Genus *Diaulula* Bergh, 1878

Diaulula punctuolata (d'Orbigny, 1837)

Material: Los Molles, two specimens (No. SSUC-183). Mehuín, one specimen (N° SSUC-2129). Punta Moquehua, Caleta Mansa, eleven specimens (N° SSUC-5278).

Previous records from Chile: D'ORBIGNY (1835-1846): Valparaíso (33° 02′ S; 71° 38′ W); BERGH (1898a): Bay Talcahuano (36° 40′ S; 73° 03′ W), South Bay Tumbes; ODHNER (1926): Melinka, Guaitecas Islands; SCHRÖDL (1996a): Bay Coliumo, Faro Corona, Seno Ventisquero; VALDÉS AND GOSLINER (2001): Península Lacuay, Chiloé Island; VALDÉS AND MUNIAÍN (2002): Lota, Peninsula Lacuay, Chiloé Island and ABRAHAM (1877): Strait of Magallanes.

General distribution: Apart from Chile, this species is also known from

Callao, Peru (DALL, 1909); Argentinian Patagonia (SCHRÖDL, 1996a, 2003) and Falklands Islands (ELIOT, 1907a).

Remarks: The generic status of the nominal species *Doris punctuolata* d'Orbigny, 1837 and *Anisodoris marmorata* Bergh, 1898 (non *Archidoris marmorata* Bergh, 1891) has received much attention (VALDÉS AND GOSLINER, 2001; VALDÉS AND MUNIAÍN, 2002; SCHRÖDL, 2003). Thus the former of this species was transferred to *Diaulula* recently by the above authors. On the other hand, the second species is transferred to *Peltodoris* Bergh, 1880 by VALDÉS AND MUNIAIN (2002).

Diaulula variolata (d'Orbigny, 1837)

Material: El Tabo, V región (33° 27′ S; 71° 38′ W), four specimens (N° SSUC-32). El Tabo, Valparaíso, one specimen (N° SSUC-53). Iquique, one specimen (N° SSUC-3333).

Previous records from Chile: BERGH, (1898a): Bay of Coquimbo (29° 57′ S; 71° 22′ W); MARCUS (1959): Bay of San Vicente (36° 44′ S; 73° 11′ W), South-Eastern Punta Gualpén, northern Chile (36° 44′ 54″ S; 73° 11′ 02″ W); SCHRÖDL (1996a): Bay Inglesa, Los Hornos, Guanaqueros (30° 10′ S; 71° 26′ W), Bay of Coliumo; SCHRÖDL (1997): Bay Inglesa (27° 07′ S: 70° 53′ W); SCHRÖDL (2003): Arica (18° 25′ S; 70° 16′ W); VALDÉS AND MUNIAÍN (2002): Coquimbo and Lota.

General distribution: This species has not been recorded outside Chile.

Remarks: VALDÉS AND MUNIAIN (2002) consider the nominal species *Doris variolata* d'Orbigny, 1837 within *Peltodoris*, but distinct from the nominal species *Anisodoris marmorata* Bergh, 1898. SCHRÖDL (2003) demonstrated that both species belong to the genus *Diaulula*, based on the presence of caryophyllidia on the notum, as well as that both are conspecific. The present study extends the known distribution of *D. variolata* much more northwards, up to Iquique.

Genus *Rostanga* Bergh, 1879

Rostanga pulchra MacFarland, 1905

Material: Totoralillo, two specimens (N° SSUC-938).

Previous records from Chile: MARCUS (1959): Playa Brava, Chiloé (41° 51′ 35″ S; 73° 49′ 20″ W), Punta El Morro, Ancud (41° 52′ 42″ S; 73° 50′ 46″ W); SCHRÖDL (1996a): Coliumo, Queule, Bay of Ancud, Faro Corona. The present study extends the geographical range towards the northern Chilean coast.

General distribution: Also recorded from Alaska (LEE AND FOSTER, 1985) to Mexico (LANCE, 1966; MARCUS AND MARCUS, 1970). It has been also collected from Argentina (MARCUS AND MARCUS, 1969).

Family TRITONIIDAE Lamarck, 1809
Genus *Tritonia* Cuvier, 1797

Tritonia odhneri Marcus, 1959

Material: Mehuín (39° 26′ S; 73° 12′ W), one specimen (N°. SSUC-2129). Duao, one specimen (N° SSUC-577). Ensenada de Tumbes (36° 37′ S; 73° 07′ W), one specimen (N° SSUC-1381). Corral (32° 52′ S; 73° 37′ W), two specimens (N° SSUC-3807).

Previous records from Chile: Punta Tenaún, Gulf of Ancud (42° 20′ S; 73° 22′ W): MARCUS (1959); Bay of Coliumo, Queule (36° 32′ S; 72° 57′ W): SCHRÖDL, 1996a.

General distribution: This species has also been recorded from northern Argentina to southern Brazil (SCHRÖDL, 2003).

Family DOTOIDAE Gray, 1853
Genus *Doto* Oken, 1815

Doto uva Marcus, 1955

Material: Punta Blanca, Tocopilla (22° 04′ S; 70° 12′ W), one specimen (N° SSUC-3038).

Previous records from Chile: MARCUS (1959): Channel of Calbuco, Gulf of Ancud in Chile; SCHRÖDL (1997a): Bay of Coliumo. SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W). The present study extends the geographical range towards the northern Chilean coast.

General distribution: This species is also known from Sao Paulo, Brazil (MARCUS, 1955, 1957, 1959).

Family FACELINIDAE Bergh, 1889
Genus *Phidiana* Gray, 1850

Phidiana lottini (Lesson, 1831)

Material: Duao, six specimens (N° SSUC-610). Caleta Leandro, Tumbes, one specimen (N° SSUC-1534). Yerbas Buenas, Tumbes, four specimens (N° SSUC-1665). El Morro, Tomé (36° 37′ S; 72° 57′ W), four specimens (N° SSUC-1936). Mehuín, five specimens (N° SSUC-2129). Punta Moquehua, Caleta Mansa, eight specimens (N° SSUC-5279).

Previous records from Chile: LESSON (1831): San Vicente; PLATE (1894): Coquimbo; BERGH (1898): Coquimbo, Cavancha, Iquique; MARCUS (1959): Punta Liles in Gulf of San Vicente (36° 43′ 36″ S; 73° 08′ 10″ W), South-East Punta Ahui (41° 50′ 10″ S; 73° 51′ 20″ W); SCHRÖDL (1996a, 2003): Los Hornos (29° 38′ S; 71° 29′ W), Queule, Lenca (41° 40′ S; 72° 40′ W), Bay of Ancud (41° 52′ S; 73° 55′ W), Bay of Coliumo; SCHRÖDL *ET AL.* (2005): Comau Fjord (42° 05′/42° 30′ S; 72° 37′/72° 21′ W). Records from the Strait of Magellan are considered erroneous (SCHRÖDL, 2003).

General distribution: Apart from Chile, this species is also known from Callao, Peru (D'ORBIGNY, 1835-1846).

Family AEOLIDIIDAE d'Orbigny, 1834
Genus *Aeolidia* Cuvier, 1798

Aeolidia papillosa (Linnaeus, 1761)

Material: Los Molles, two specimens (N° SSUC-183). Los Morros, Coliumo, two specimens (N° SSUC-1113). Puerto Inglés, Tumbes (36° 37′ S; 73° 07′ W), six specimens (N° SSUC-1619). Traiguén, Tumbes, four specimens (N° SSUC-1743). El Morro, Tomé, one specimen (N° SSUC-1936). Punta Moquehua, Caleta Mansa, six specimens (N° SSUC-5279).

Previous records from Chile: BERGH (1898a): In the Magellanic province, Seno Almirantazgo; MARCUS (1959): North-West from Islote Quenu (41° 49′ 15″ S, 73° 10′ 15″ W), East from Punta Corona (41° 47′ 12″ S, 73° 52′ 23″ W), North from Islote Cochinos (41° 49′ 25″ S, 73° 48′ 58″ W), North from Gulf of Ancud between Tres

Cruces and Punta Piedras, Bay Tumbes and Punta María in Agua Fresca, Strait of Magellan (53° 22′ S, 70° 57′ W); SCHRÖDL (1996a): Faro Corona; SCHRÖDL (2003): Bay of Coliumo. With the present study the distribution has been markedly extended northwards, up to Los Molles.

General distribution: *Aeolidia papillosa* is a worldwide species in temperate waters (SCHRÖDL, 2003; THOMPSON AND BROWN, 1984). In southern America it has been also recorded from Falkland Islands (BERGH, 1898) and Argentinian Patagonia (SCHRÖDL, 1996a).

Family FIONIDAE Alder and Hancock, 1851
Genus *Fiona* Alder and Hancock, 1851

Fiona pinnata (Eschscholtz, 1831)

Material: Mehuín, Valdivia, two specimens (N° SSUC-2129).

Previous records from Chile: BERGH (1898a): Juan Fernández Islands and Tumbes, Talcahuano (Chile Central).

General distribution: *Fiona pinnata* is a cosmopolitan species (SCHMEKEL AND PORTMANN, 1982; GOSLINER, 1987); recorded off northern Peru (D'ORBIGNY, 1835-46) and from Lobos Islands, northern Peru (SCHRÖDL, 1996a; 2003).

DISCUSSION

To date the number of known opisthobranchs in Chile amounts to 75 species distributed in 51 genera and 34 families, all of them recorded in Table II. The present study provides records of 18 opisthobranch species: 2 sacoglossan, 1 pleurobranchid and 16 nudibranchs, all previously known from Chile.

The Nudibranchia form the most diverse clade of opisthobranchs in Chile, consisting of 57 species. Among them *Thecacera darwini* is a well-known and very common species along the entire Chilean coast, just as *Phidiana lottini* and *Diaulula variolata*.

Chilean opisthobranch species descriptions too poor to warrant reidentification, or currently considered as *nomen dubium* or *nomen nudum*, are not included in Table II. These are: *Doris delicata* Abraham, 1877, *Doris tomentosa* Cuvier, 1804 (*sensu* Abraham, 1877), *Doris amarilla* Pöppig, 1829, *Doris magellanica* Cunningham, 1871, *Doris chilensis* Abraham, 1877 and *Acanthodoris vathelei* Rochebrune and Mabille, 1891. The holotype of the latter species has probably been mislaid (V. Heros, personal communication).

Eleven species reported in the literature are still unidentified: one sacoglossan (*Limapontia* sp., SCHRÖDL, 1999a) and ten nudibranchs (*Doris* sp., SCHRÖDL, 1996a; *Dendronotus* sp., SCHRÖDL, 1996a; *Tritonia* sp1., SCHRÖDL, 2003; *Flabellina* sp. 1, SCHRÖDL, 1996a, *Flabellina* sp. 2, SCHRÖDL, 1996a; *Eubranchus* sp. 1, SCHRÖDL, 1996a; *Eubranchus* sp. 2, SCHRÖDL, 1996a; *Cuthona* sp. 1, SCHRÖDL, 1996a; *Cuthona* sp. 2, SCHRÖDL, 1996a; Tergipedidae sp. 1, SCHRÖDL, 2003).

On the other hand, the opisthobranch collection of Couthouy reported on by GOULD (1852) has been lost. Due to the poor description of this material, both species *Doris luteola* Couthouy in Gould, 1852 *nomen dubium*, and *Doris plumulata* Couthouy in Gould, 1852 *nomen dubium* could not be included in Table II.

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Erratum

Figure 2, page 70, of the following article

> Ávila, S. P., Santos, A. C., Penteado, A. M., Rodrigues, A. M., Quintino, I. and Machado, M. I. The molluscs of the intertidal algal turf in the Azores. *Iberus*, 23 (1): 67-76.

was printed with a mistake. The correct figure (with the names *Littorina striata* and *Melarhaphe neritoides* correctly placed) is included here.

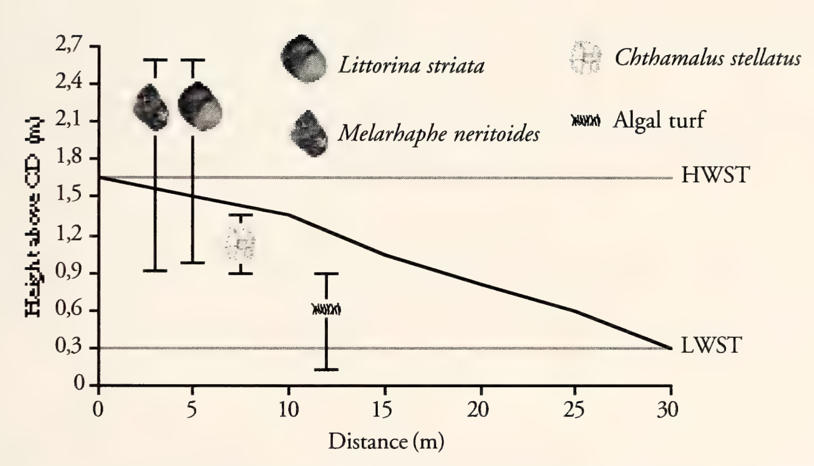


Figure 2. Transect performed at Poça do Pano (Lajes do Pico, Pico island) and vertical distribution of rocky shore organisms. HWST: mean high water level at spring tides; LWST: mean low water level at spring tides.

Figura 2. Transecto realizado en Poça do Pano (Lajes do Pico, isla de Pico) y distribución vertical de organismos de costa rocosa. HWST: nivel medio superior del agua en mareas de primavera: LWST: nivel medio inferior del agua en mareas de primavera.

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Dendrodoris limbata **(Cuvier, 1804)**
Sinonimias
Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Localidad tipo: Marsella].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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Fretter, V. y Graham, A., 1962. *British Prosobranch Molluscs.* Ray Society, London, 765 pp.

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Ros, J., 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoolgica*, 3 (5): 21-51.

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Figura 1. *Neodoris carvi.* A: animal desplazándose; B: detalle de un rinóforo; C: branquia.

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INSTRUCTIONS TO AUTHORS

• *Iberus* publishes research papers, notes and monographs devoted to the various aspects of Malacology. Papers are manuscripts of more than 5 typed pages, including figures and tables. Notes are shorter papers. Monographs should exceed 50 pages of the final periodical, and will be published as Supplements. Authors wishing to publish monographs should contact the Editor. Manuscripts are considered on the understanding that their contents have not appeared or will not appeared, elsewhere in substantially the same or any abbreviated form.

• Manuscripts and correspondence regarding editorial matters must be sent to: Serge Gofas, Editor de Publicaciones, Departamento de Biología Animal, Universidad de Málaga, Campus de Teatinos, s/n, 29071, Málaga, Spain.

• Manuscripts may be written in any modern language.

• When a paper exceeds 20 pages, extra pages will be charged to the author(s) at full cost.

• Manuscripts must be typed double spaced (including the references, figure captions and tables) on one side on A-4 (297x210 mm) with margins of at least 3 cm. An original and two copies must be submitted, together with a floppy disk containing the article written with a DOS or Macintosh word processor. When a paper has joint authorship, one author must accept responsability for all correspondence.

• The authors must include a list of at least 4 possible referees; the Editor can choose any others if appropriate.

• Papers should conform the following layout:
First page. This must include a concise but informative title, with mention of family of higher taxon when appropriate, and its Spanish translation. It will be followed by all authors' names and surnames, their full adress(es), an abstract (and its Spanish translation) not exceeding 200 words which summarizes not only contents but results and conclusions, and a list of Key Words (and their Spanish translation) under which the article should be indexed.
Following pages. These should content the rest of the paper, divided into sections under short headings. Whenever possible the text should be arranged as follows: Introduction, Material and methods, Results, Discussion, Conclusions, Acknowledgements and References. Unusual abbreviations used in the text must be grouped in one alphabetic sequence after the Material and methods section.

• Notes should follow the same layout, without the abstract.

• Footnotes and cross-references must be avoided. The International Codes of Zoological and Botanical Nomenclature must be strictly followed. The first mention in the text of any taxon must be followed by its authority including the year. In systematic papers, when synonyms of a taxon are given, they must be cited IN FULL, including the periodical, in an abbreviate form, where they were described, and the type localities in square brackets when known. Follow this example (please note the punctuation):

***Dendrodoris limbata* (Cuvier, 1804)**
Synonyms
Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Type locality: Marseille].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

These references must not be included in the Bibliography list, except if referred to elsewhere in the text. If a full list of references of the taxon is to be given immediately below it, the same layout should be followed (also excluding those nowhere else cited from the Bibliography list).

Only Latin words and names of genera and species should be underlined once or be given in *italics*. No word must be written in UPPER CASE LETTERS. SI units are to be used, together with their appropriate symbols. In Spanish manuscripts, decimal numbers must be separated with a comma (,), NEVER with a point (.) or upper comma (').

• References in the text should be written in small letters or SMALL CAPITALS: Fretter and Graham (1962) or FRETTER AND GRAHAM (1962). The first mention in the text of a paper with more than two authors must include all of them [Smith, Jones & Brown (1970)], thereafter use *et al.* [Smith *et al.* (1970)]. If an author has published more than one paper per year, refer to them with letters: (Davis, 1989a; Davis, 1989b). Avoid *op. cit.*

The references in the reference list should be in alphabetical order and include all the publications cited in the text but only these. ALL the authors of a paper must be included. These should be written in small letters or SMALL CAPITALS. The references need not be cited when the author and date are given only as authority for a taxonomic name. Titles of periodicals must be given IN FULL, not abbreviated. For books, give the title, name of publisher, place of publication, indication of edition if not the first and total number of pages. Keep references to doctoral theses or any other unpublished documents to an absolute minimum. See the following examples (please note the punctuation):

Fretter, V. and Graham, A., 1962. *British Prosobranch Molluscs*. Ray Society, London, 765 pp.
Ponder, W. F., 1988. The Truncatelloidean (= Rissoacean) radiation - a preliminary phylogeny. In Ponder, W. F. (Ed.): Prosobranch Phylogeny, *Malacological Review*, suppl. 4: 129-166.

Ros, J., 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoológica*, 3 (5): 21-51.

• Figures must be original, in Indian ink on draughtsman's tracing paper. Keep in mind page format and column size when designing figures. These should be one column (57 mm) or two columns (121 mm) wide and up 196 mm high, or be proportional to these sizes. Two columns format is recomended. It is desirable to print figures with their legend below, so authors are asked to take this into account when preparing full page figures. If computer generated graphics are to be included, they must be printed on high quality white paper with a laser printer. Photographs must be of good contrast, and should be submitted in the final size. When mounting photographs in a block, ensure spacers are of uniform width. Remember that grouping photographs of varied contrast results in poor reproduction. Take account of necessary reduction in lettering drawings; final lettering must be at least 2 mm high. In composite drawings, each figure should be given a capital letter; additional lettering should be in lower-case letters. A scale line is recomended to indicate size, magnification ratio must be avoided as it may be changed during printing. UTM maps are to be used if necessary. Figures must be submitted on separate sheets, and numbered with consecutive Arabic numbers (1, 2, 3,...), without separating 'Plates' and 'Figures'. Legends for Figures must be typed in numerical order on a separate sheet, and an Spanish translation must be included. Follow this example (please note the punctuation):

Figure 1. *Neodoris carvi.* A: animal crawling; B: rinophore; C: gills.

If abbreviations are to be used in illustrations, group them alphabetically after the Legends for Figures section.

Authors wishing to publish illustrations in colour will be charged with additional costs (30,000 ptas, 180 euros per page). They should be submitted in the same way that black and white prints.

If the authors want to send Figures in digital format, CONTACT the Editor first.

• Tables must be numbered with Roman numbers (I, II, III,...) and each typed on a separate sheet. Headings should be typed on a separate sheet, together with their English translation. Complex tables should be avoided. As a general rule, keep the number and extension of illustrations and tables as reduced as possible.

• Manuscripts that do not conform to these instructions will be returned for correction before reviewing.

• Authors submitting manuscripts will receive an acknowledgement of receipt, including receipt date, and the date the manuscript was sent for reviewing. Each manuscript will be critically evaluated by at least two referees. Based of these evaluations, the Editorial Board will decide on acceptance or rejection. Anyway, authors will receive a copy of the referees' comments. If a manuscript is accepted, the Editorial Board may indicate additional changes if desirable. Acceptable manuscripts will be returned to the author for consideration of comments and criticism; a finalized manuscript must then be returned to the Editor, together with a floppy disk containing the article written with a DOS or Macintosh word processor. Dates of reception and acceptance of the manuscript will appear in all published articles.

• Proofs will be sent to the author for correcting errors. At this stage no stylistic changes will be accepted. Pay special attention to references and their dates in the text and the Bibliography section, and also to numbers of Figures and Tables appearing in the text.

• Fifty reprints per article will be supplied free of charge. Additional reprints must be ordered when the page proofs are returned, and will be charged at cost. NO LATER orders will be accepted.

La Sociedad Española de Malacología

Junta Directiva desde el 14 de noviembre de 2000

La *Sociedad Española de Malacología* se fundó el 21 de agosto de 1980. La sociedad se registró como una asociación sin ánimo de lucro en Madrid (Registro N° 4053) con unos estatutos que fueron aprobados el 12 de diciembre de 1980. Esta sociedad se constituye con el fin de fomentar y difundir los estudios malacológicos mediante reuniones y publicaciones. A esta sociedad puede pertenecer cualquier persona o institución interesada en el estudio de los moluscos.

SEDE SOCIAL: Museo Nacional de Ciencias Naturales, c/ José Gutierrez Abascal 2, 28006 Madrid, España.

CUOTAS PARA 2005:

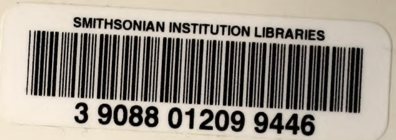
Socio numerario	(en España):	40 euros
	(en Europa)	40 euros
	(fuera de Europa):	48 euros
Socio estudiante	(en España):	23 euros
	(en el extranjero):	29 euros
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Cada socio tiene derecho a recibir anualmente los números de *Iberus, Reseñas Malacológicas* y *Noticiarios* que se publiquen.



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